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Reports from the AMERICAN CHEMICAL SOCIETY meeting in Chicago

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Editorial:
Fundamental Stuff of the Universe
Inside Front Cover

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A SCIENCE SERVICE PUBLICATION

Fundamental Stuff of The Universe

➤ THE STORY of the kinds of atoms has been long in composition, with many minds and hands putting it together. The ancients knew and recognized some of the elements, such as gold, silver, copper, etc., found in their native state. Others, even some of the most common, long remained hidden, in disguise of some other element or in the crudeness of early chemistry.

There are just so many kinds of matter out of which the universe is made. Man has been able to discover 103 chemical elements — some of which he has created for a very momentary existence, and others like hydrogen and helium which seem to hold a heavy and stable majority in the universe. Some of these elements have been found or created in only the few years after the great atomic energy push. There are hundreds of varieties of these elements — isotopes they are called — many artificially radioactive and not found in nature.

The present frontier of the chemical elements lies in the mystery of what composes them. Just what more fundamental particles make them up and what laws and forces keep their nuclei together is the prime question of physical science. Scientists are trying to pry loose the answer with cosmic rays and gigantic accelerators.

* * * *

This editorial is taken from the preface to the book, "The Chemical Elements" by Helen Miles Davis. Send Fifty cents to CHEMISTRY, 1719 N Street, N.W., Washington 6, D. C. for a copy of the 1961 edition.

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Highlights from the 140th National Meeting of the American Chemical Society at Chicago in September

Sawdust Steaks

Sawdust can taste like steak when hemists put the flavor in it, the merican Chemical Society meeting as told.

The flavor in meat is caused by mple chemical compounds that can reproduced and placed in foods fore cooking to produce a mouth-atering meat flavor at will, Dr. Wen-ell A. Landmann of the American eat Institute Foundation, Chicago, ported.

Meat has been separated into water-luble materials, fat, and water-in-luble materials, Dr. Landmann ex-ained. After heating these fractions, e scientist found the meat flavor d aroma only in the water-soluble material. Further separation of this material showed that the fundamental meat flavor could be produced from two compounds, inosinic acid and a protein that contained sugar. These compounds in themselves have no odor, but when these are mixed and heated with fat or water, the odor and taste of broiled or boiled meat is obtainable, he said.

"The housewife will be able to tailor meat flavor to suit individual tastes of her family and she can be sure of uniform flavor quality when she purchases a steak," Dr. Landmann said. Applications to space-feeding and to the synthetic foods for future populations are also being explored.

Organic Research

Synthetic Rubber Breakthrough

A breakthrough in rubber science w permits the industry to make y kind of synthetic rubber that is eded, George R. Vila, president of nited States Rubber Co., said at the 0th national meeting of the Ameri-n Chemical Society.

Mr. Vila and three of his company's entists described three new types synthetics superior in many ways materials now in use and likely to bring improvements to tires, conveyor belts, golf balls and other products.

We have entered a revolution in rubber and rubber-like materials, said Mr. Vila, who served as chairman of this joint symposium of the society's rubber and petroleum sections on synthetic elastomers from petroleum hydrocarbons.

"We have shaken ourselves free from the molecular designs of mother nature and the previously uncontrollable course of synthetic molecular structure. We can now build molecules exactly to the specifications we wish."

Ethylene-propylene rubber is a highly versatile class of rubbers, Dr. Robert J. Kelly told the symposium. It can be made extremely resistant to ozone cracking and weathering and has a generally well balanced set of physical properties. EPR, as it is called, has the bounce of natural rubber, the wear of general-purpose styrene-butadiene rubbers and the ozone resistance of butyl.

U. S. Rubber scientists developed successful synthetic balata as an outgrowth of studies in stereo-regular polymerization that began in 1954. The substance is a moderately hard, tough, crystalline thermoplastic material known by the chemical name of "trans 1,4 polyisoprene."

Synthetic balata's development is expected to free the rubber industry from dependence on natural balata latex, which must be bled from the bark of the balata tree deep in the jungles of South America. The natural product has become more difficult an expensive to obtain because each sea son workers must go farther into th jungle in search of trees.

Vinyl pyridine synthetic rubber i extremely resistant to abrasion an gives higher performance with th addition of certain inorganic chem cals, said Dr. William F. Bruksch Jr It will perform well in tire treads an conveyor belts, where abrasion resis tance is an advantage in longer wea

Mr. Vila foresaw further research t develop polymers with the ultimat in resistance to heat, light, oxygen ozone and high-energy radiation. Sur vival on other planets will require u to meet the demands of extreme tem perature ranges, entirely new atmos pheres and bombardment by cosmi radiation.

Dr. Kelly was assisted in the prep aration of his technical paper by Dr Harold K. Garner, Dr. Henry E Haxo and William R. Bingham.

Co-authors with Dr. Lasky were Dr. Roswell H. Ewart and Dr. Gar ner.

Dr. Bruksch is a research scientis with the company's Naugatuck Chem ical division working at the Researc Center.

Witch Doctors' Brew

➤ A WITCH doctors' secret poison, once used as an instrument of terror, has now been made in the laboratory, it was reported at the 140th national meeting of the American Chemical Society.

Synthesis of the poisonous sub stance, which occurs in a West Afr can shrub called "ratsbane," was an nounced by Dr. F. L. M. Pattiso and R. E. A. Dear of the Universit of Western Ontario, London, Ontari

Extremely toxic to all warm-blooded animals, ratsbane was extensively used in Africa at one time as a rat-killer, an arrow poison, and a fatal contaminant in enemy water supplies.

"It was employed to even greater effect by the local witch doctors for terrorizing the native population," Dr. Pattison said. "European doctors knew the symptoms only too well, but in the early days they did not know what material the witch doctors used, so no cures were possible.

"Then in 1904 a young Mendi laborer called Johnny ate some fish which had been poisoned with ratsbane for killing rats. He soon developed the well known symptoms. So the witch doctors' secret was out."

Paralysis of the lower limbs is one of the characteristic symptoms of ratsbane poisoning, according to Dr. Pattison, leading to a second common name for the shrub — "brokeback."

The toxic agent from ratsbane was not identified chemically until 1960, when it was concluded by Sir Rudolph Peters, an English chemist, that the substance is a fluoro-oleic acid, the second organic chemical containing fluorine ever to be found in nature. It is closely related chemically to oleic acid, a constituent of ordinary fats, Dr. Pattison explained.

The other naturally occurring organic fluorine compound is fluoroacetic acid, also a highly toxic constituent of African plant species.

The synthesis was undertaken, Dr. Pattison reported, in order to confirm the structure of the ratsbane poison. It is not expected to be of any immediate practical use.

Starting point for the synthesis was a simpler fluorine-containing compound, 8-fluoro-octyl bromide, the chemist said. Intermediates included several materials related to acetylene. The final synthetic product proved to be identical with the toxic substance from ratsbane, thus demonstrating that the proposed structure was correct.

Dr. Pattison's paper was given before the Fluorine Subdivision of the Division of Industrial and Engineering Chemistry, one of 23 units of the American Chemical Society devoted to the various branches of chemistry and chemical technology.

Straight-Jacketed Molecules

A CHEMIST has put straight jackets on violent molecules so they can be handled in research on rocket fuels, he told the American Chemical Society.

Dr. Jack Radell of the Frankford Arsenal, Philadelphia, said he and his colleagues have trapped highly explosive "alkyl perchlorate" molecules inside holes in crystals of urea.

In spite of their potential use as oxidizers for rocket fuels, little work has been done with these long, snake-like molecules because of their dangerous instability, he explained. The percholorate "head" of one molecule

may violently attack a neighboring alkyl "tail" — or even its own. The molecules also react explosively with water, he said.

The urea straight jackets keep out water and also prevent the molecules from attacking their neighbors or turning back on themselves, the speaker reported.

Safe handling of the alkyl perchlorates for study and possible use in the explosives and jet fuel fields may now be possible, he said.

The alkyl perchlorates, prepared for the first time by Dr. Radell and his coworkers, are all explosive liquids. The compounds with the shortest alkyl "tails" are the most sensitive to shock, it was indicated.

Treating the alkyl perchlorates with urea in a solution of alcohol resulted in the formation of the urea straight jackets, or "inclusion compounds."

"Formation of urea inclusion compounds converted the liquid alk perchlorates to characteristic wh crystalline masses of fine needle Dr. Radell said. "The resulting cr talline complexes had no appare shock sensitivity in small quantitie

Alkyl perchlorates with tails co taining 5 to 8 carbon atoms in a cha were studied. The ease of formati of the urea inclusion compounds w proportional to the chain lengths the alkyl perchlorates, Dr. Rad stated.

The chemical structure of the ur crystals containing the alkyl perchl rate molecules was verified by studi using X-rays and infrared spectra, was reported.

Captain J. W. Connolly of t Wright-Patterson Air Force Base ar A. J. Raymond of the Wyandott Chemical Corporation, Wyandott Michigan, were co-authors of the p per.

Tapping Oil Shale Deposits

➤ Progress in tapping the trillion-barrel oil potential of a vast Colorado oil shale deposit was reported to the American Chemical Society by a Government chemist.

For the first time kerogen, the oil-forming portion of the shale, has been freed from the tight-clinging mineral portion without drastically changing the kerogen. Until now the mineral has greatly hampered utilization studies, said D. L. Lawlor of the U.S. Bureau of Mines, Laramie, Wyo.

The proportion of the troublesom material, called pyrite, has been r duced from 5 to .02 per cent with new chemical technique based on compound called lithium aluminu hydride, he said.

Used in conjunction with estal lished methods of removing impur ties, the technique produces a keroge containing only about 1 per cent tot minerals. Investigations of the re atively unaltered sample now mak possible research that may lead

icient ways of exploiting the huge ale deposit, Mr. Lawlor told the CS Division of Fuel Chemistry.

"Oil shale is one of the greatest tapped natural resources in the nited States," he continued. "The quid fuel potential of the oil shale posits located in northwest Colo-do in the Green River formation is uivalent to more than one trillion rrels of crude oil.

"This quantity of oil is several nes more than all the natural petro-um produced in this country since was first discovered in 1859, plus r present proven reserves of petro-um. This natural resource warrants udy and development so that it can l a need in our ever expanding de-and for energy from liquid fuels."

Kerogen, the organic portion of oil ale, converts to oil when treated to 0-900 degrees Fahrenheit, the speaker explained. Its intimate mixture with minerals stems from the fact that it was formed from aquatic plants in prehistoric lakes in which rocks, silt, and soluble minerals were carried by rivers and streams.

More than one-half of the oil shale is composed of the mineral portion which has greatly handicapped studies to determine the character of kerogen, according to Mr. Lawlor, who added:

"For the first time, kerogen can be separated from the mineral matter by chemical methods without drastic changes in the structure of kerogen. As a result, more information about the structure of kerogen and the method by which kerogen is converted to useful products should be obtained from the constitution studies."

Such information, he pointed out, is important to the process engineer in designing new and better methods of utilizing this vast natural resource.

Sugar Modified Resin

A STRONGER, cheaper plywood for terior use may result from a new nding resin made in part from gar, a New York chemist told the merican Chemical Society's 140th tional meeting.

The resin is of the phenolic type esently used in preparing exterior ywood but incorporates a large per-ntage of sugar in the resin mix, it as reported by Dr. Oleg Kononenko, esident of Herstein Laboratories, c. Exterior plywood, which it wide-used in building, obviously needs be highly resistant to water.

"The use of water-soluble sugar to modify phenolic resins may sound absurd, because even small amounts of unreacted sugar could be leached out by water to weaken the bond," said Dr. Kononenko, who is an organic and pharmaceutical chemist. "However, in the single-step process we have developed, which can be carried out in 20 to 30 minutes, sugar is completely bound chemically.

"The plywoods made with these resins have withstood 13 days or cycles of successive boiling and drying. Commercial exterior plywood samples usually delaminated after seven or eight cycles."

Tensile strength of the plywood — the force needed to pull it apart — could be changed by varying the proportions of the resin mix and the reaction conditions, Dr. Kononenko reported. Tensile strength attained was somewhat higher than that of plywood using ordinary phenolic resins.

"The percentage of wood failure ranged from 80 to 100 percent, which demonstrates that the resin bond is stronger than the wood itself," Dr. Kononenko said.

"Wet tensile strength, determined after boiling the plywood, was substantially the same, demonstrating that the binding strength was not affect by water."

Sugar used in the new resins places about half the phenol norma used, and since the price of sugar substantially less than that of phen the product offers distinct econom advantages, the speaker pointed out.

Co-worker with Dr. Kononenko developing the new resin was Claren D. Chang, now with the M. W. K logg Company, Jersey City, New J sey. The paper was presented befc the American Chemical Society's D vision of Organic Coatings and Pl tics Chemistry.

Plastic Electrical Conductors

➤ Plastics, long considered excellent electrical insulators, have now been made to conduct electricity — even as well as some metals — a Princeton researcher told the American Chemical Society.

"Semiconduction" has been observed in more than 200 types of plastics, or polymers, made at the Princeton University Plastics Laboratory, according to Dr. Herbert A. Pohl, a physical chemist and senior research associate at the Princeton Engineering School. Further research along this line may eventually lead to plastic electronic components, new de-salters for seawater, and fundamental discoveries about photosynthesis, vision, and sunlight-induced skin cancer, he indicated.

Midway between the metals, which carry an electric current very well, and insulators, which do not carry one at all, the new semiconducting plastics have promising properti which point the way to use in certa electronic devices, particularly thc operating at high temperatures. B their use in transistors can not yet foreseen, Dr. Pohl said.

De-salting of seawater and oth large scale chemical transformatio may be possible with semiconducti polymers by taking advantage of the unique combination of large surfa area, semiconducting properties, a the reactive chemical sites along the chain-like molecules, it was suggeste They could operate much as a wat softener does in removing salts fro water, except that the regenerati step would be replaced by passing electric current through the materi

A number of important biologic processes involving the action of lig on plants and animals — such photosynthesis, vision, development skin cancer, and certain enzyme

tions — all closely involve semi-
nduction Dr. Pohl said. Study of
e process by which the new materi-
s carry an electric current is expected
give fundamental information about
ese biological processes.

That semiconduction occurs in the
w materials by a fundamentally dif-
rent process than that occurring in
e materials in common use as tran-
stors, is shown by their insensitivity
small amounts of impurities, Dr.
hl reported.

Best known in the form of plastics
d synthetic fibers, polymers are compounds with extremely long molecules. Molecules of the new polymers have many units of unsaturation (like those in unsaturated fats) arranged in a special way, which permits them to carry an electric current, it was explained.

Materials synthesized in the present study are not the first semiconducting polymers to be prepared, Dr. Pohl said. However, the present work represents the first extensive study of a whole family of polymers of known structure and good ability to carry a current.

norganic Research

Man-Made Halogen Studies

RESEARCH on an element that doesn't
ist in nature has confirmed some
ndamental ideas about all chemical
ements, the American Chemical
ciety was told.

New facts learned about the man-
ade, radioactive element astatine
ve fulfilled scientists' predictions,
hich were based on the known prop-
ties of natural elements, Dr. Evan
. Appleman of the Argonne Na-
nal Laboratory reported to the
ciety's Division of Inorganic Chem-
try.

First prepared in 1940 in the Uni-
rsity of California cyclotron by No-
l Prize-winner Emilio Segre, asta-
ne is so unstable that half of a
mple changes to another substance
eight hours. It is so intensely radio-
tive that only about one billionth
a gram can be handled at one time — much too small an amount to be seen or weighed.

Astatine has remained the only obscure member of a well known family of elements called the halogens, which includes fluorine, chlorine, bromine, and iodine.

Chemists have long wanted more information about astatine, Dr. Appleman said, in order to verify predictions they have made about its properties compared with the other members of the halogen family. Principles established in this way can be extended to other families of elements.

The work carried out at Argonne National Laboratory established that the properties of astatine did correspond to the principles thought to govern the behavior of the halogens, Dr. Appleman reported.

"For instance," he said, "the halo-

gens are classified as non-metals. In fact, they are the most non-metallic of all the elements. However, as we go to the heavier members of the group, we find them beginning to act more and more like metals, and this tendency is most pronounced in astatine, the heaviest halogen.

"We may generalize this result and conclude that, other things being equal, the heavier an element is, the more metallic will its behavior be."

Techniques used in studying the properties of astatine included the incorporation of minute amounts of astatine compounds in crystals of other, closely related halogen compounds, and the distribution of astatine and astatine compounds between layers of water and carbon tetrachloride, the physical-inorganic chemist explained.

"The name halogen means salt-forming," Dr. Appleman said, "and refers to one of the most characteristic properties of these elements. Thus from chlorine, for instance, comes sodium chloride, our common table salt.

"Astatine, the heaviest member the group, is a strange sort of bea All of its isotopes are short-lived a highly radioactive. There is no su thing as a stable astatine — hen this element cannot exist in nature.

"To correlate successfully the tren in properties among the halogens need a rather thorough knowledge all members of the group. In t absence of detailed information abo astatine, it was difficult to draw re able conclusions about the halog family as a whole.

"The chemical elements are of su diverse nature that it is virtually i possible to comprehend the enti spectrum of chemical behavior sta ing from scratch. It is much mo fruitful to look at a group of elemer like the halogens.

"This simplifies things considerabl and it is usually possible to und stand the differences in behavior th do exist within the family in ter of a few fundamental principles. The principles may then be used to int pret the behavior of the rest of t chemical elments."

Drinking Water Safe From Nuclear Attack

➤ A NUCLEAR WAR will not permanently contaminate our water supply, scientists were told at the American Chemical Society meeting.

A mobile water purification unit has been developed that removes 97% of the plutonium in contaminated water at the rate of 1,500 gallons of water per hour, Maurice Pressman, U.S. Army Engineer Research and Development Laboratories, Fort B voir, Va., said.

Although the amount of polluti from a nuclear attack or an accid in an atomic plant is uncertain, t equipment is believed to be capable reducing contamination to the le set by the National Committee Radiation Protection as safe durin 30-day emergency period.

Plutonium, used as an explosive component of nuclear weapons and as fuel for nuclear reactors, is now in large-scale production in the U.S. If the element gets into the body, it tends to concentrate in the bones and can cause tumors or injure the sensitive bone marrow, site of most blood cell formation.

The purification equipment, stored in a van-type object on a two and a half ton truck, can be put into operation within an hour after arrival at the emergency site, it was reported.

Normally, the unit removes 72% of the contamination. By making the water very alkaline, this can be increased to 97.5% in an emergency. Neutralization with acid would then make the water safe and drinkable.

Paints Protect Space Craft

Orbiting with the American satellite Tiros III is a new family of paints designed to protect space craft from excessive heat, the American Chemical Society was told.

By reflecting radiation from the sun and other extra-terrestrial sources, the new coatings may help control the temperature of vehicles carrying spacemen or payloads, reported Merle L. Sibert of the Lockheed Aircraft Corporation's Missile and Space Division, Sunnyvale, Cal. Their formulation of white powders, based on alkali silicates, also avoids compounds that tend to decompose or discolor paints under the drastic conditions in space, he said.

Laboratory tests made previous to the July 12 launching indicated that the paints are capable of "maintaining their optical, chemical, and structural stability for extended periods in the space environment" and far exceed existing requirements, he said at a technical session of the ACS Division of Organic Coatings and Plastics Chemistry.

During the laboratory studies the paints withstood 2,000 hours of sun in a vacuum and were not affected by extreme conditions of temperature and radiation. Their composition, alkali silicates and high purity white ceramic type pigments, contains no discoloring organic materials such as oils, plastics, or silicones, Mr. Sibert pointed out, continuing:

"In current and projected space vehicles, some form of temperature control must be incorporated into the design in order to provide a proper environment for payloads and ultimately for personnel. These vehicles, when placed in the space environment are subjected to high vacuum, extreme temperature fluctuations, and severe solar and other extra-terrestrial radiation.

"Temperature control might be achieved by devices such as refrigeration-heating systems. These have not generally been used due to limited availability of power on vehicles. The alternate or passive system involves the use of mosaic surfaces consisting of the proper distribution of solar reflecting and absorbing areas which, in conjunction with internal heat conduction paths, permit reasonable temperature control of the vehicle.

"Coatings employed for this purpose must not only possess the desired absorbing or reflecting characteristics, but they must retain these characteristics over periods of months or years while in the space environment. In addition, they must retain their structural integrity and be chemically stable."

The new surface coatings whic "reflect most of the solar radiatio and emit strongly in the infrare region," provide the basis for one a proach to a passive temperature co trol system for space vehicles, M Sibert said.

Biochemistry Research

Capromycin, New Antibiotic

➤ A NEW antibiotic has been discovered which kills streptomycin-resistant TB germs in mice, a biochemist told the American Chemical Society.

In the animal experiments the new agent, called capromycin, was as potent as streptomycin or PAS, drugs commonly used against tuberculosis in human beings, and also was effective against the resistant organisms, according to Dr. Earl B. Herr Jr. of Eli Lilly and Company, Indianapolis. The new antibiotic is produced by a previously unidentified strain of microorganism called *Streptomyces capreolus,* it was reported.

After long treatment with a particular drug, the mycobacteria which cause tuberculosis are known to acquire immunity. Because of this resis tance to tuberculosis drugs, a potential new agent is of keen interest to doctors, the biochemist pointed out at a technical session of the ACS D vision of Biological Chemistry.

Capromycin has a limited range activity and is active primarily again mycobacteria, Dr. Herr continue Absence of any cross-resistance b tween streptomycin and capromyci has been demonstrated both in th test tube and in the mouse, he sai adding:

"Mycobacteria gradually develop r sistance to streptomycin when grow in a medium enriched with the ant biotic but remain sensitive to capr mycin. Tests in a capromycin-enriche medium showed that resistance the new antibiotic also develops gra ually."

Clinical tests of capromycin a planned, according to the repor Michael E. Haney Jr. and Gail Pittenger, both Eli Lilly biochemist were co-authors.

Asthma From Dust

➤ A HIGH incidence of asthma among University of Minnesota students may be related to two kinds of airborne dust particles isolated by a woman biochemist, she told the American Chemical Society.

Minute quantities of the material tested on allergic students, cause positive skin reactions, according t Velta Goppers, associate scientist the University's school of publi health. This indicates that the con

ounds are of considerable biological gnificance and "may be one of the easons for the occurrence of asthma." ne said.

Collected at three testing stations n the campus, the particles have een partially identified and shown o be in a chemical class called poly-lycoside peptides. During the course f the research Miss Goppers devel-ped a new process for separating omplex mixtures, based on a scienti-c technique called electrophoresis.

There is some evidence that the ompounds "are parts of large mole-ules in nature which are degraded to certain stage where they act as al-rgins," she reported at a session of ne ACS Division of Analytical Chem-try.

The research, prompted by concern ver the higher than normal incidence f asthma at the Twin Cities univer-ty and sponsored by a National nstitutes of Health research grant, pproaches the problem from two di-ections, Miss Goppers explained. It nvolves both medical studies of the udents and environmental analysis f the area, which is surrounded by ndustry primarily involved in milling nd malting of grain, animal food reparation, linseed and soybean pro-uction, and grain storage.

Students who have asthma and suffer asthmatic attacks receive treatment at the allergy clinic and are enrolled in the study group, Miss Goppers said, adding:

"The environmental study involves gathering data on weather parameters, determining the concentrations and composition of dust and gases, and studying the spread of the air contaminants through the campus area.

"The newly detected compounds both are found at all three testing stations in varying amounts during the summer and winter months.

"The work reported in my paper is an integral part of the research project, since we have been able to isolate and partially identify two compounds from a mixture of material extracted by solvents from a sample of airborne particles. Micro quantities of these two compounds, when skin tested on certain students, gave positive sensitization reactions. This indicates that these airborne compounds are allergenic and may be one of the reasons for the occurrence of asthma. We feel this is quite significant and have been encouraged to investigate further along these lines."

Dr. Harold J. Paulus, associate professor at the University of Minnesota School of Public Health, was co-author.

Chemical Test to Help Lengthen Life

A CHEMICAL test may help extend fe for a substantial proportion of the opulation, Dr. Herbert L. Davis of ne University of Nebraska reported. Details of the test procedure were re-orted at the American Chemical Society's 140th national meeting.

The test measures the total fats in the blood stream. It is expected to provide a screening procedure for patients suspected of having arteriosclerosis and other disorders of di-

gestion and utilization of fats. Conspicuously high values in the test would justify further procedures to determine the separate kinds of fats present, he indicated.

The results will show the effects of exercise, reduced fats in the diet, substitution of polyunsaturated fats fo the saturated ones and the use o various drugs.

It is hoped that screening for tota lipids may become as common and a valuable as the X-ray test for tube culosis.

Anti-Depression Drugs

➤ A NEW SERIES of compounds designed to combat mental depression without causing jitters, insomnia, or other bad effects was described at the American Chemical Society's 140th national meeting.

One of the agents produces a fourfold increase in the spontaneous activity of mice, according to Dr. Robert L. Clarke of Sterling-Winthrop Research Institute, Rensselaer, N. Y. This most potent member of the series, called "dl-threo-alpha-benzyl-N-ethyltetrahydrofurfurylamine," is now undergoing careful evaluation, the chemist said.

Normally, mice interrupted a light beam in their cage 250 times in a 30-minute period. When given minute doses of the new drug (16 milligrams per kilogram of body weight), the activity was increased to more than 1,000 interruptions in the same period. Stimulation was apparent at doses as low as one milligram per kilogram of body weight, Dr. Clarke told the ACS Division of Medicinal Chemistry.

"The treatment of mental depression at all levels from mild to psychotic has been a continuing problem for physicians," Dr. Clarke said. "Amphetamine, a central nervous system stimulant, has been widely used in these cases. Unfortunately, it causes side effects such as jitteryness, in somnia, tremors, increase in heart rat and elevated blood pressure.

"Amphetamine tends to cause ove stimulation rather than acting as simple antidepressant. Recently, mono amine oxidase inhibitors have bee used as antidepressants, but they hav already fallen into disrepute due t serious side effects such as liver dam age. To date, electroshock therapy ha remained the most effective treatmen for depressed phychotic patients.

"In the course of general researc at the Sterling-Winthrop Research In stitute, directed toward developmen of drugs to fill such pressing needs a noted above, we encountered a series c benzyltetrahydrofurfurylamines whic dramatically increased the spontane ous activity of mice.

"The most active stimulant of thi series is *dl*-threo benzyl-N-ethyltetra hydrofurfurylamine. It is approximate ly twice as active as dl-amphetamin as a psychomotor stimulant in mice This new drug is receiving a carefu evaluation to determine whether it has desirable antidepressant propertie without the side effects which hav limited the use of earlier stimulants.

Dr. Louis S. Harris, also of Ster ling-Winthrop, was coauthor of thi paper.

Drug-Eating Organisms Aid Waste Disposal

Drug-eating organisms are solving a serious disposal problem scientists were told at the American Chemical Society meeting.

The disposal of the liquid process wastes from the manufacture of antibiotics such as penicillin has created a major problem since World War II, Dr. Ross E. McKinney of the University of Kansas, said. The wastes are 20 to 40 times as concentrated as domestic sewage.

A new method has now been developed using microorganisms that can eliminate the wastes in a single stage process, Dr. McKinney reported. This is the first biological waste treatment process to be designed from the microbiological viewpoint, he said.

Previous methods using microorganisms, called activated sludge methods, did not have oxygen transfer equipment that could meet the oxygen demand in the aeration tank. The new process distributes the organic wastes over the entire aeration tank so that there is no high oxygen demand rate as in conventional activated sludge.

"Mathematical equations have been developed which permit accurate design of the complete mixing activated sludge systems. These equations permit the engineer to know what results to expect before the plant is put into operation and to evaluate operation problems which may arise," Dr. McKinney concluded.

Cancer Caused by Mistake of Virus

Cancer may be a mistake of a virus, scientists were told at the American Chemical Society meeting.

A virus is a very complicated chemical compound with two parts: the nucleic acid, which has the reproducing information, and the protective coating, which is made of protein, Dr. M. P. Gordon, University of Washington, told the meeting. The nucleic acid of the virus is almost identical with the nucleic acid of the cell it infects, and the virus can fool the cell into using virus nucleic acid and reproducing virus, he said.

The deception does not always work, however, and the infected cell may produce defective and abnormal cells instead of viruses.

Scientists can now fool the virus, Dr. Gordon reported. They change the chemistry of the nucleic acid with similar chemicals, called analogs, and make the virus less effective. In some cases, the analogs prevent the virus from infecting the cell altogether.

When the analog of an amino acid, 5-fluorouracil, is incorporated into the simple plant virus, tobacco mosaic virus, the virus has difficulty infecting new cells and is more susceptible to certain chemical agents, Dr. Gordon said. The virus also becomes more

sensitive to the type of radiation used in tumor treatment.

"It is generally found that compounds incorporated into nucleic acids also inhibit the multiplication of viruses in infected tissues" Dr. Gordon continued. "They are often non-infectious or their ability to initiate infections and transfer genetic information to other cells is reduced. Th genetic message carried by the viru is often garbled, resulting in mu tants."

Nucleic acids that contain analog are also more sensitive toward th action of a variety of physical an chemical treatments. This is the bas of cancer chemotherapy.

New Fluorine Anesthetic

➤ A NEW, non-flammable, inhalation anesthetic has been produced from a fluoride compound once considered too unstable to be of value, a Michigan chemist told the American Chemical Society.

The potent, long-lasting anesthetic reduces the need for post-operative narcotics and minimizes possibilities of overdosage, according to its discoverer, Dr. Eric R. Larsen of the Dow Chemical Company, Midland. It was developed by removing instability-causing by-products from methoxyflurane, chemically defined as (2,-2-dichloro-1, 1-difluoroethyl methyl ether), he said.

On long exposure to oxygen the new compound, unlike the impure material, does not form explosive peroxides. It is compatible with nearly all drugs commonly used in surgery and can be applied with conventional anesthesia apparatus without modifications or special attachments, Dr. Larsen told the ACS Division of Industrial and Engineering Chemistry.

First prepared in Great Britian i 1940, methoxyflurane, a halogenate ether, remained a laboratory curiosit because of the impurities which mad it unstable. A method developed t remove the impurities provided material with a shelf life of severa years, Dr. Larsen said, commenting:

"Methoxyflurane is a non-flammabl liquid having a pleasant, fruit-lik odor. It is a potent anesthetic agen that produces profound relaxation c large muscles with minimal depre sion of the central nervous system The new anesthetic is less apt tha other halogenated inhalation ane thetics to cause sharp drop in bloo pressure and unstable heart rhythm Its low volatility practically eliminate the danger of accidental overdosage.

The research, stemming from th investigation of a wide variety fluorine-containing compounds as p tential inhalation anesthetics, was joint project of Dow Chemical, Co nell University Medical College, an Abbott Laboratories, North Chicago

CHEM EVALUATION 1960-61

This is the third in a series of articles concerning the progress being made in the Chemical Education Material Study or the CHEM Study. This investigation of the high school chemistry curriculum is supported by the National Science Foundation as is the Chemical Bond Approach Project at Earlham College. The CHEM Study has been reported in the January 1961 and March 1961 issues of CHEMISTRY.

THE MAJOR emphasis of the Study uring its first six months of existence as to prepare a text and laboratory anual for use in the trial schools in 960-61. This effort was successful. The number of students involved in e twenty-four trial schools this year as about 1,300. The number in the me schools during the year 1961-62 ill be around 3,000 and the total umber of students using the material mewhere between 12,000 and 13,000 uring 1961-62. It has been interesting note the impressions of the teachers ncerning the materials since they st saw it, approximately August 1, 960.

At that time, it is safe to say each of e teachers was quite skeptical as to hether the material could successlly be handled by high school stuents. At the end of the four week ssion at Claremont, a considerable nount of this skepticism remained, id many teachers felt more firmly based in it. The fact that, after a year of use, each of them now desires to use the materials again, is perhaps some evidence concerning the feasibility of the program. All members of the staff, contributors, and participants agree that the first set of materials was far from perfect but feel that evidence of the first year has not only indicated areas that need most work, but has also shown that the general emphasis, content, and level are not unrealistic.

The second emphasis has been to acquaint as many people as possible with what the Study is doing, to keep them interested and providing the kind of information which would be a real contribution in planning the Study's progress, while at the same time being unable to allow them to use the materials in their own schools. Along this line, the staff has met with more than 5,000 teachers of science at professional meetings throughout the country.

A third emphasis has been to begin the preparation of motion pictures and other materials ancillary to the text and laboratory manual. Progress in these fields has been deliberately slow, to assure integration of films and materials with the text and the course. Film production, for example, is so expensive, making every effort to insure that the first films will set a high level of excellence towards which the rest can then be aimed: one which will allow potential users to have a real criterion as to the general contributions of films to the over-all program.

Now that they have established more definitive goals and areas of concentration they feel that they can proceed with plans for publication and presentation of a full course by the fall of 1963, the original goal of the Study.

Materials Revised

Immediately after the close of the school year last June, the trial teachers and contributors met with the staff at Berkeley for a three day session. Subgroups were assigned the task of evaluating and reappraising the textual materials in the trial edition. One of the main concerns was the excessive time spent last year on the overview section of the text. The following order of chapters for the text was agreed upon.

Titles for Chapters in the Text

1. Chemistry: An Experimental Science
2. Scientific Models and Atomic Theory
3. Atoms Combined in Substances
4. The Gas Phase: Kinetic Theory
5. Liquids and Solids
6. Chemistry and the Periodic Table
   Supplementary Reading — Geochemistry
7. Energy
8. Rates
9. Equilibrium
10. Ionic Solutions
11. Acids and Bases
12. Oxidation-Reduction
13. Stiochiometry
14. Believing in Atoms
15. Electrons and Periodic Table
16. Molecules in Gases
17. Bonding in Liquids and Gases
18. Carbon Chemistry
19. The Halogens
20. The Third Row
21. The Second Column
22. The Transition Elements
23. Biochemistry

The new schedule for the cours calls for the following distribution time:

1. Experimental Method — Chapt 1 2 weeks
2. Overview of Chemistry — Chapt 2-7 7 weeks
3. Chemical Reactions Principles — Chapters 7-13 11 weeks
4. Atomic Structure Chemical Bond — Chapters 14-17 6 weeks
5. Descriptive Chemistry — Chapte 18-23 8 weeks

Volume I of the text contains th first six chapters and is ready for th opening of school this fall in som 125 trial schools. The laboratory e periments which accompany the fir 13 chapters of the texts are include in Volume I of the laboratory manu and are listed below.

The complete set of materials i cluding Volumes II and III of th text and Volume II of the laborato manual will be available at a cost all interested teachers in Februa 1962.

List of Experiments for the First Semester

Experiment

Part I Observation and Interpretati — Precision of Measurement

1. Scientific Observation and D scription

2. Observing Regularities
3. The Melting Point of a Pure Substance
4. Chemistry of a Candle
5. Heat Effects

rt II An Overview of Chemistry — The Mole Concept — Avogadro's Principle — Solutions
6. The Reaction of Solid Copper with a Solution of Silver Nitrate
7. The Empirical Formula of a Compound
8. The Formula of a Hydrate
9. Mass Relationships in a Chemical Reaction
0. Comparing the Weights of Gases
1. The Relation Between the Weight and Volume of Hydrogen
2. Some Aspects of Solubility
3. Reactions Between Ions in Solution

rt III Investigation of Chemical Reactions
4. A Study of Reactions
5. The Heat of Reaction
6. A Study of Reaction Rates I
7. A Study of Reaction Rates II
8. Applying Le Chatelier's Principle to Some Reversible Chemical Reactions
9. Chemical Equilibrium
20. The Heat of Some Acid Base Reactions
21. Indicators and the Determination of an Ionization Constant
22. A Quantitative Titration
23. An Introduction to Oxidation Reduction
24. Electrochemical Cells
25. Ionic Reactions

ppendix
A-1. Description of a Burning Candle
A-2. Laboratory Techniques
A-3. Measurement — Metric System
A-4. Some Mathematics Useful in Chemistry—Exponents, Adding Equations, Graphing Relationships
A-5. Precision in Measurement — Experimental Errors

Testing Program

In order to estimate the extent to which the new CHEM Study course got across to the group of students participating in the preliminary tryout, a series of five sequential achievement tests was developed and administered throughout the academic year 1960-61. Since these tests were developed and carefully reviewed by the senior editors of the textbook and laboratory manual, among others, they may be deemed to sample the kinds of learning consistent with the over all objectives of the CHEM Study course. In other words, they may be said to have a high degree of "content validity."

The data from these tests are reminiscent of the extraordinary findings in students in connection with the Physical Science Study Committee. As with the PSSC data the correlation of the CHEM Study achievement test scores with those on the aptitude test are inordinately low as compared with similar correlations of aptitude against the multitude of traditional achievement tests in high school chemistry.

In summary, it can be stated with positive assurance that, given a group of students such as those who were enrolled in the CHEM Study Course during 1960-61 and teachers of equal caliber, the course most certainly would produce equally dramatic results. During the coming academic year a much larger, and presumably more representative group of students will be using the course materials that were revised during the summer of 1961. Hopefully the results based on this more representative group will prove to be as significant and promising as those of the students who participated in the original tryout.

Highlights from the Fifth International Congress on Biochemistry at Moscow in August

Key Biochemical Machine

➤ A FULL account of an eight-year study of the mitochondrion — a key biochemical machine that is the principal energy provider of all oxygen-using cells — was given by Dr. D. E. Green, University of Wisconsin professor.

When enlarged a million times, the mitochondrion looks like an elongated cake in which large numbers of raisins are embedded in regular array, Dr. Green told the International Congress of Biochemistry.

The raisins are the elements that do the work of the mitochondrion, and the cake is the structural network in which the raisins are mounted and supported.

"Each raisin," Prof. Green said, "is known as the elementary particle, which is the complete functional unit. There are some 17,000 such units in a single mitochondrion of beef heart."

These particles carry out the complete oxidation of pyruvic acid (an acid normally produced in the body during a stage in the breaking down of carbohydrates or proteins) to carbon dioxide and water. During this combustion process, energy of oxidation is converted to chemical energy that is stored in the chemical, adenosine triphosphate or ATP.

Prof. Green said that in the structural arrangement he described as raisins in a cake, the raisins differ from one biochemical machine to another but the cakes in which these particles are embedded are much the same in design and arrangement.

"Two elements make up the cake," he said, explaining that a special protein known as the structural protein, which is a huge polymer (a long molecule), is inextricably tied up with lipid. The biochemical raisins are imbedded within this matrix of structural protein and lipid, and the matrix serves to keep the functional elements in just the right shape and posture to do their work properly.

Prof. Green said "the elementary particle has a kind of bucket brigade for moving electrons from pyruvic acid to oxygen," which is a basic step in the oxidation of sugar. At least 11 different components are lined up in sequence to make up this chain.

"If we think of the oxidation of pyruvic acid as the transfer of electrons from pyruvic acid through the chain and finally to oxygen," he said, "then in the passage of a pair of electrons through this chain, three

molecules of inorganic phosphate are converted to the terminal phosphate groups of ATP."

Some of the most important biochemicals have a place of honor on this chain, Prof. Green said. They include flavin, one of the B vitamins, the active component of red blood cells; iron in a form other than heme iron; copper, and a newly discovered benzoquinone called coenzyme Q.

Chemical "Brain" DNA

THE CHEMICAL "brain' of a virus that orders the creation of more viruses has been isolated for the first time. It is not like a real brain, but is the chemical unit that gives instructions for formation of another virus.

The chemical is deoxyribonucleic acid, or DNA. It is a double-strand "brain," shaped like two intertwined corkscrews, and can be isolated from the virus and transplanted into a new host cell where it begins to function again.

The discovery gives scientists a system that they can control in their research for clues to the basic genetic code governing the production of living cells. It was reported to the Fifth International Congress on Biochemistry.

Drs. Earl Evans Jr., Roy P. Mackal and Franz Meyer, all of the University of Chicago, have shown for the first time that DNA by itself can command a complete new cell. The "assistance" of proteins or ribonucleic acid is not necessary.

DNA is thus shown to be identical with the genetic matter of the cell. It was isolated from the virus known as lambda. Examination of the chemical properties of the lambda DNA shows that it resembles those of the DNA found in the genes of living cells in possessing double helical structure.

"This is the first time that a DNA having a double helical structure has been shown to be infectious," the biochemists said.

Before any major claims can be made for the code-breaking capability of the double-stranded lambda virus DNA, attempts must be made to do the "deciphering job," they said. Theoretically, with each variation that is made in the test tube in DNA's chemical structure, a similar change will result in the type of protein manufactured.

They said the laboratory work took advantage of the knowledge that the lambda "languishes inside an intestinal bacillus of man in another chemical form, called a 'provirus'."

New Technique Discovered

AN IMPORTANT tool is seen in the discovery of a new technique for separating and measuring the sub-units of large protein molecules.

Dr. Francis J. Reithel, head of the University of Oregon chemistry department, reported his new technique at the Fifth International Congress on

Biochemistry. Up to now geneticists have had to use small protein molecules, which are not numerous. Separation of the sub-units of large molecules will give access to a larger number of molecules for this research.

The new technique involves dissolving purified proteins in a chemical reagent known as guanidine hydrochloride. Dr. Reithel uses an ultracentrifuge, a refined version of apparatus that separates material by rotation.

To separate the sub-units, Dr. Reithel used a technique called sedimentation equilibrium, in which diffusion of the molecules offsets centrifugation. The molecular weights are determined from readings on photographs, taken while the ultracentrifuge is in motion.

Ordinarily the sedimentation equilibrium process takes days, but by using a very short column of one millimeter or less of protein solution in the ultracentrifuge the experiments were reduced to a few hours. This use of a short column is less than two years old.

For his protein material Dr. Reithel uses enzymes, a class of organic substances that accelerate specific transformations in living cells. Dr. Reithel produced a pure form of an enzyme called betagalactosidase, which comes from a common intestinal bacterium.

This enzyme appeared to have a molecular weight of 700,000, but it also showed evidence of having smaller functional units. Preliminary observation indicates a molecular weight of 35,000 for each of 20 sub-units.

Dr. Reithel said the analytical technique of combining the short column, sedimentation equilibrium method with the use of guanidine hydrochloride is a very convenient and powerful tool for determinating molecular weights on very small quantities of material. He is now studying methods for preventing the separated sub-units from rejoining.

Tranquilizer Affects Enzyme

➤ Phenothiazine tranquilizers, used to depress the central nervous system and induce sleep, may be producing their effects by speeding the action of an enzyme in the brain, five biochemists from the University of Nebraska Hospital, Omaha, reported.

The effect of this particular group of compounds was described as "the most striking" observed in a general study of what tranquilizing agents do to enzymes, the catalysts that increase the rate of chemical reactions in cells.

Phenothiazine drugs were shown to step up the activity of a brain enzyme called L-glutamic decarboxylase. The enzyme changes glutamic acid to gamma-aminobutyric acid, which inhibits the functions of the central nervous system.

Dr. Herbert P. Jacobi, Dr. David Rosenberg, Dr. M. J. Carver, John Haggstrom, and Martha Kelly, of

the University's biochemistry department, made their announcement at the International Congress of Biochemistry.

Their study is based on the theory that the body's chemical processes are based on enzyme activity, and that the chief action of drugs to treat diseases is one of interference with enzymes.

Information on drug-enzyme interaction is expected to give new insight on disease causes, as well as to help determine what drugs should be prescribed for varying types of ailments.

Controversial Theory Proposed

➤ A CONTROVERSIAL theory of how insulin controls diabetes was described by a University of Maryland professor at the Fifth International Congress on Biochemistry.

How insulin actually works in the body has never been clarified despite successful isolation of the hormone from pancreatic tissue for control of diabetes some 40 years ago, Dr. Samuel P. Bessman of the University's School of Medicine, Baltimore, said. The body hormone, which is necessary to prevent diabetes, affects the absorption of sugar but equally affects the production of starches and fats.

Dr. Bessman discussed the relationship of his own findings to the broader problems of protein synthesis and the release of cellular energy in the body. He believes that insulin may act as a "metabolic clutch" in releasing energy within living cells.

His theory is that insulin binds trypotophan, a protein building block, to muscle protein. It acts, he believes, to connect mitochondria to the enzyme in the cell. By making the mitochondria more efficient, the insulin gives all cells a boost.

Mitochondria are little particles in the cell that generate energy in usable form as metabolic fuel. They are a mobile power unit, but they have to be near to what they give power. A special enzyme in the cell is needed to get the particles operating.

This enzyme is usually free in the cell, and it is Dr. Bessman's theory that insulin connects this enzyme to the mitochondria.

Early Earth's Surface

➤ THE EARTH'S surface in its early years of life may have glowed like a beautiful rainbow, shimmering with the colorful array of light emitted by primitive organisms.

Light emission may have occurred soon after life appeared on earth, when the atmosphere lacked oxygen, Drs. W. D. McElroy and H. H. Seliger of Johns Hopkins University, Baltimore, Md., reported at the International Congress of Biochemistry.

In removing the oxygen by the use of organic reducing substances, an excited state was produced resulting in the emission of light. The surviving

organisms were therefore all potentially luminescent. Thus began the oxygen-using metabolism evident in most present day organisms.

After the aerobic system became well established the luminescent systems no longer had a selective advantage. Nevertheless they continued to exist and are now found in certain bacteria, fungi and the firefly.

The compound that makes the firefly glow, luciferin, was recently synthesized for the first time by Dr. McElroy and three other scientists at Johns Hopkins University. The firefly's luminescent system was adapted for a secondary purpose, the identification of the female firefly by the male.

As small amounts of oxygen appeared in the atmosphere, not all of the organisms could tolerate the presence of oxygen. However, those that could quickly and rapidly remove the oxygen by reduction with hydrogen or electrons from primitive foodstuffs survived.

Body Fights Foreign Protein

➤ New facts reported at the Fifth International Congress on Biochemistry indicate that the reaction of the body to foreign proteins is chiefly the reaction of general rather than specific cells within the body.

The reaction to foreign protein, of which some allergies are examples, is actually a build-up of antibodies to any foreign protein, also known as an antigen.

Dr. F. Haurowitz of Indiana University, Bloomington, working with M. Richter and S. Zimmerman, reported that, contrary to popular belief, antibody production does not stop after the first injection of an antigen. Even after a single injection, antibody production continues in rabbits for more than a year.

The second injection causes immediate formation of antigen-antibody complexes and these complexes act as a strong stimulus for the antibody-forming cells. The antibody content of the blood then increases rapidly.

The findings are in opposition to the theory proposed by the Australian Nobelist, Sir F. Macfarlane Burnet, that the body has built-in cell types and that each type can maunfacture antibodies of only one type. When antigen A is injected, those cells that form anti-A will be stimulated to excessive growth and multiplication, the theory states.

This theory does not explain how the body can react against unnatural proteins manufactured by chemists, but not found anywhere as natural substances. Presumably the body would have cells prepared to deal only with naturally occurring substances.

The explanation proposed by the scientists indicates that the antibody-forming type of cell has the ability to form antibodies against any type of antigen, not just one.

Sulfa Tricks Enzymes

Sulfa drugs can fight human infections because enzymes are tricked into using them instead of a specific acid.

Dr. Gene M. Brown of Massachusetts Institute of Technology told the Fifth International Congress on Biochemistry that a large part of sulfonamide and a small amount of para-aminobenzoic acid means the formation of very little folic acid, and thus little chance of bacterial growth.

In the 20 years during which sulfa drugs have been in use, scientists and physicians have not been able to pinpoint just why they were so effective.

The chemical properties of sulfonamides and para-aminobenzoic acid are so similar that it is possible to fool the enzymes, which are the "mechanics" of bacterial growth, into using them in place of the acid.

Sulfonamides are not toxic to animals, which do not manufacture the vitamin folic acid, but the animals are continually in need of a dietary supply of the acid. Sulfa drugs or compounds fed to an animal do not affect the animal directly, but do prevent the growth of infection-causing bacteria by "inhibiting the enzymatic formation of folic acid by these bacteria."

Photosynthetic Process Less Simple

Photosynthesis — the conversion of light into energy by living cells — is not as simple as that observed in green plants.

By isolating the photosynthetic process from the complex living cell, scientists have found that the process is independent of oxygen and more closely linked with absorbing phosphorus. Scientists normally view photosynthesis in plants as converting carbon dioxide to sugars while giving off oxygen to the air.

Photosynthetic cells are distinguished from other cells by their ability to form two products from light energy, ATP (adenosine triphosphate) and TPNH-2 (reduced pyridine nucleotide). The formation of these products is largely responsible for converting carbon dioxide to sugars. The reaction is accompanied by the evolution of oxygen, which to the casual observer seems to require more light energy.

It is these outward reactions that have resulted in the popular definition of photosynthesis.

University of California scientists in Berkeley carried on cell-free photosynthetic experiments by removing chloroplasts from spinach leaves. Chloroplasts are tiny particles of green leaves that contain the chlorophyll pigments where photosynthesis takes place.

The results of the experiments were presented to the International Congress of Biochemistry by University of California professor, Dr. Daniel I. Arnon.

Proudly Presented

Announcing new developments in the chemical industry and newly available chemical literature.

Static Electricity

➤ A NEW chemical that eliminates static electricity has freed record collectors from becoming dust collectors.

The new anti-static agent, developed and produced by American Cyanamid Company under the trade name Catanac SN, is being used by RCA Victor as an additive in its record mix.

George R. Marek, vice president and general manager of RCA's Record Division, said recently that the solution of the dust problem is "one of the greatest technical advances in recording in a decade."

Static electricity attracts dust to the surface of phonograph records which, in turn, results in a high-pitched scratch that interferes with perfect reproduction of sound. The more sensitive your recording equipment is, the more annoying the dust interference.

RCA's search for an efficient anti-static agent began more than 10 years ago, but the problem was solved only when scientists at American Cyanamid Company's laboratories in Stamford, Conn. discovered that Catanac SN made an excellent anti-static agent when added to the record mix. The chemical had been previously used as an emulsifier to mix such different liquids as oil and water and as a detergent to separate soil particles from cloth.

Further tests have proved that Catanac SN also eliminates surface charges of static electricity in paper, plastics, textiles and many other materials. It has also made possible the development of furniture polishes which leave a dust-repelling surface and fabrics which do not attract lint and dirt.

In addition to using Catanac SN as the standard anti-static agent for all of its stereophonic records produced in the United States, RCA's Custom Sales department has also offered its use to many independent record manufacturers for stereophonic long-playing record production.

Space-Age Fabric

➤ A NEW space-age clothing material developed to protect personnel manufacturing and handling missile fuels is expected also to play a useful safety role throughout industry.

Developed by Du Pont and tested by the military, the material is known as "Armalon" fluorocarbon laminated fabric 97-00-A. It consists of aluminized "Teflon" FEP-fluorocarbon film laminated to a fabric made of "Teflon" TFE-fluorocarbon fiber. Government agency tests report this new type of "Armalon" is more resistant to all chemicals tested, including gaseous fluorine, chlorine trifluoride, and penta-borane, than any suitable fabric constructions yet evaluated.

So new that manufacture of protective garments for those working with high energy fuels is just beginning, "Armalon," according to the Du Pont industrial fabrics development group, should soon find a place in lines of

standard industrial safety and protective equipment, including outerwear, gloves, aprons, and the like.

"Armalon" 97-001A is manufactured under U. S. Patent 2,773,781, issued to the Du Pont Company. It is made at the company's Fairfield, Conn., plant, and is available at $69 per yard in 24-inch widths.

Where protection against flash fires is not required, the film-to-cloth laminate is available without the reflective aluminized coating. This quality is designated 97-001 and is priced at $59 per linear yard.

Data sheet and swatch sample may be obtained by writing Room WT-902, Du Pont Company, Wilminton 98, Del.

Acids and Anhydrides

➤ A NEW 48-page booklet, describing the properties and uses of organic acids and anhydrides, has just been published by Union Carbide Chemicals Company.

The booklet contains comprehensive data on acetic, propionic, butyric, 2-ethylbutyric, 2-ethylhexoic, acrylic, sorbic, valeric, and isodecanoic acids; acetic, propionic, and butyric anhydrides.

Included is information on physical properties; constant-boiling mixtures; specification limits; test methods; storage, handling, and shipping; toxicological properties; and selected literature references.

Organic acids are used mainly as intermediates and acidifying agents while the anhydrides find their main application in the formation of esters under conditions where no reaction would take place with the corresponding acid.

One or more of the acids, or their derivatives, can be used as solvents; esterifying, acidifying, and neutralizing agents; extractants; epoxidizing agents; gasoline sweetners, oil-well fracturing agents; wood impregnants; soil conditioners; corrosion inhibitors; and in the manufacture of insecticides ,food preservatives, fungicides, pharmaceuticals, plasticizers, thermoplastic and thermosetting resins, adhesives, textile finishes, herbicides, flavors, perfumes, lubricants, dyestuffs, varnish and enamel driers, cosmetics, surface coatings, detergents, emulsifiers, floor polishes, foundry core and mold binders, gasoline additives, resin modifiers and stabilizers, rubber-processing and compounding chemicals, and other applications.

Anhydrides are of special interest for treatment of petroleum and food oils; in the manufacture of acetate fibers, plastics, coatings, films, cellulose esters, pharmaceuticals, brake fluids, edible fats and oils, plasticizers, perfumes and odorants, flavors, polymerization catalysts, fly baits, explosives, weed killers, dyestuffs, fungicides, and fire-resistant paper and textiles.

Liquid Neopreme Coating

➤ DEVELOPMENT of a new, improved liquid neoprene protective coating is announced by Adhesive Products Corporation, 1660 Boone Avenue, New York 60, New York. Designated APCO Liquid Neoprene Coating, it is DuPont neoprene rubber in an easy-to-use liquid form, which can be applied by brush or paint roller. APCO dries in minutes, forming a continuous rubber film on metal, wood, plastic, concrete and other surfaces, which is impervious to fresh and salt water,

oils, gasoline, naptha, acids and alkalies and other chemicals.

It is permanently flexible and will not peel, blister or crack under changing climatic conditions. It offers prolonged protection against rust, mildew, fungus, sunlight and humidity, and is ideal for protecting and weatherproofing a wide variety of materials.

It is recommended for boats, outdoor furniture, metal fences and railings, garden tools, tarpaulins, tents, tractors, machinery and equipment. It is ideal for repairing and waterproofing leaking roofs, chimney flashings and pipe joints; rust-proofing metal cabinets and trash cans; coating drains, ducts, garden hoses and tents; protecting darkroom equipment; and insulating and rust-proofing air conditioners. APCO will also find wide use in plant maintenance and in skid-proofing floors, ladders and other surfaces.

APCO Liquid Neoprene Coating is available in pint, quart, one-gallon and five-gallon cans and in 55-gallon drums. The material has a shelf life of more than twelve months when stored in a sealed container.

Teflon Filaments

➤ Monofilaments made of "Teflon" FEP-fluorocarbon resin are under study by a filaments marketing section of Du Pont's Polychemicals Department for possible use in brush applications where problems result from contact with acids and chemicals.

Because of the stable, anti-frictional characteristics of "Teflon," monofilaments of the FEP-fluorocarbon may provide a premium bristling material for brushes which face exposure to corrosive elements, extreme temperatures and sticky ingredients.

Inert to virtually all industrial chemicals and solvents, "Teflon" resins retain their effectiveness at extremely low temperature, have the lowest coefficient of friction of any known materials, and are flame resistant.

Brushes containing FEP monofilaments for use in chemical and petroleum laboratories, photoengraving plants and other areas with cleaning and brushing problems related to acids and chemicals are prime market possibilities.

"Teflon" FEP monofilaments are available in diameters of five and 11 mils, but other sizes can be supplied for developmental purposes. P. J. Wayne, Polychemicals Department, Du Pont Company, Wilmington 98, Del., is in charge of the program.

N-Butyl Alcohol Bulletin

➤ A revised and greatly expanded data bulletin on n-butyl alcohol has just been released by U. S. Industrial Chemicals Co., Division of National Distillers and Chemical Corporation.

This 12-page bulletin contains U.S.I. specifications for n-butyl alcohol in addition to resin solubilities, chemical references. A large section on physical properties is included, as well as an extensive list of binary and ternary azeotropes.

U.S.I.'s new bulletin is specifically designed to provide information on n-butyl alcohol for the surface coatings and chemical processing industries. Copies are available from Technical Literature Department, U.S. Industrial Chemicals Co., 99 Park Avenue, New York 17, N. Y.

ilicones for Electrical Insulation

A NEW eight-page two-color publi-ation, "Silicones for Electical Insula-ion," is available from the Silicone roducts Department of General Elec-ic, Waterford, New York.

Designated CDS-288, the publica-on is complete with more than 20 hotographs and charts providing val-able data and examples of silicones n use in a wide variety of electrical nd electronic applications.

Included are sections on silicone arnishes for impregnating and pro-ective coatings, clear and opaque pot-ng and encapsulating materials, pres-ure sensitive adhesives, dielectric uids, dielectric greases, wire and able insulation and combination con-ructions of silicones with other ma-rials. Also shown are some of the eneral Electric testing facilities hich are available for development f new products and applications and ne solution of complex customer roblems.

The publication is available upon ritten request.

ood-Grade Triethylene Glycol

AVAILABILITY in commercial quan-ties of high-purity triethylene glycol, ecently cleared by Food and Drug dministration for use in food pack-ging materials, has been announced y The Dow Chemical Company, idland, Michigan.

Dow said the premium grade meet-ng FDA conditions of less than 0.1 er cent of diethylene glycol has a ide range of applications as a plas-cizer or humectant in cellulosic food ackaging materials, and in cork seals r bottled foodstuffs and beverages.

The FDA regulation published in THE FEDERAL REGISTER lists two conditions of use: that the food additive contain less than 0.1 per cent of diethylene glycol; it is used or intended for use as a plasticizer in cellulosic food-packaging materials.

Dow will market the product under the name triethylene glycol HP (high purity) at a premium price 1½ cents a pound above technical grade prices currently 18½ cents a pound in the eastern freight zone and 19½ cents a pound in the western zone in tank car quantities.

Polypropylene

➤ PROPERTIES and characteristics of Tenite polypropylene are described in Materials Bulletin No. 9, issued by Eastman Chemical Products, Inc.

Capable of being injection molded or extruded on the same equipment used for other thermoplastics, the newest addition to the Tenite family of plastics is said to possess exceptional moldability qualities, particularly apparent in difficult-to-fill mold patterns. Other properties attributed to Tenite polypropylene are its low density, its high stiffness in flexure, and excellent resistance to heat, impact, stress-cracking and chemical attack.

Three tables appended to the bulletin present technical data covering (1) the resistance of Tenite polypropylene to chemical; (2) typical physical properties of the plastic in injection molding; and (3) suggested formulas for various methods of processing.

Materials Bulletin No. 9 is available on request from the plastics division, Eastman Chemical Products, Inc., subsidiary of Eastman Kodak Co., Kingsport, Tennessee.

Color-Coded Pipets

➤ A COMPLETE line of pipets which are color-coded for ease of identification has been introduced by Corning Glass Works.

The Pyrex brand blass pipets are coded by bands of color according to capacity and graduated interval. In addition, the capacity is printed in matching colors above the bands.

The line features a new size pipet with a capacity of 5/10 ml. graduated in 5/100 ml. intervals.

According to Corning, over 70 types and sizes of pipets make up the color-coded line, including the Mohr measuring type, long tip measuring and serological types, taper top, cotton mouth and large tip opening measuring and serological types.

Color-coding is available on pipets with regular Pyrex brand white-filled, lifetime red or accu-red markings.

The color-code is located opposite the regular pipet inscription.

The bands and numbers are silk-screened and permanently fired onto the glass. The color meets the chemical durability standards set by federal specification DD-V-581-a.

The pipets are made of hard, low-expansion borosilicate glass, noted for its chemical durability. The cost of the new color-coded pipets is the same as the regular Pyrex brand pipets.

Stabilized Methyl Parathion

➤ VICTOR CHEMICAL WORKS, Division of Stauffer Chemical Company, has developed a new, stabilized form of methyl parathion. It is now being introduced on a national basis under the trade name Stabilized T-80 methyl parathion.

The new product offers several sig nificant advantages to formulators Because it has a full 80% concentra tion, less material need be sprayed o absorbent carriers which, in turn yields drier, more free-flowing dus bases. Such formulated dusts also con tain less solvent so that weight los through evaporation is reduced. More over, the higher concentration of th toxicant reduces spray time and there by minimizes labor costs.

Extensive laboratory and field test have established that dust formula tions of the new product are stabl over a wide range of conditions Stabilized T-80 methyl parathion i resistant to heat and hydrolysis an also to the catalytic degradation whic results from contact with certain type of clays and absorbents.

An 8-page research report on thi new product is available from th Victor Division Sales office in Chi cago. Samples are also available fron the same source, but because of it toxicity require special arrangements

Victor will warehouse Stabilize T-80 methyl parathion at all regula methyl parathion stock points.

New Copolymers

➤ ANTARA CHEMICALS, a Division o General Aniline & Film Corporation New York, announces the first three products in a new series of water emulsion copolymers of vinylpyrroli done. They will be available initiall in development quantities only an will be marketed under the registere trademark "POLECTRON." Thi series represents the Company's firs entry into water-emulsion polymers.

The first three products in this new group will be called Polectron 130 — which is a vinylpyrrolidone/ethy

rylate copolymer emulsion; Polec- on 430 — a vinylpyrrolidone/styrene polymer emulsion; and Polectron 0 — another vinylpyrrolidone/sty- ne copolymer emulsion. Each has 40% solids content.

The features of the Polectron series en up new possibilities for water- nulsion polymers in that they offer e receptivity, unusual emulsion sta- lity, excellent adhesive properties, d unique film-forming properties.

Some of the applications for these w products will be in the adhesives ld, where they will bond diverse aterials to each other. Additional hesives uses will be found in tex- e coating, paper coatings, and glass er sizes. The superior dye recep- ity exhibited by these products will ake them highly desirable as non- oven fiber binders and latex rug ckings. Since these new film form- s, in addition to their adhesion prop- ties also show great toughness, eval- tion as surface coatings — particu- rly as metal primers and top coat- gs for wood — is indicated. They ve considerable potential, further- ore, as acid-stable detergent opaci- rs and as aerosol starch resins.

Some of the properties inherent in these new emulsion polymers are due to their vinylpyrrolidone content. These products have excellent freeze-thaw stability, shear stability, acid and salt tolerance. They can be cross-linked by exposure to temperatures of 100° C or higher for one-half to one hour.

All three of the first Polectron copolymers are insoluble in the following solvents: water, ethyl alcohol, ethyl acetate, acetone, methyl ethyl ketone, benzene, carbon tetrachloride, heptane, and dioxane. Exceptions will be found in Polectron 430 which is partly soluble in benzene and Polectron 450 which is partly soluble in water.

While currently available in development quantities only, Antara Chemicals intends to make tank car quantities available before the end of 1961 at reduced prices.

Additional information may be obtained from The Acetylene Chemicals Department, Antara Chemicals, a Division of General Aniline & Film Corporation, 435 Hudson Street, New York 14, New York.

Drinking Water Standards

Radioactivity concentrations in rinking water have been limited by e U. S. Public Health Service for e first time.

Dr. Luther L. Terry, PHS Surgeon eneral, said the radioactivity limits ere three micro microcuries per liter r radium-226; 10 micro microcuries er liter for strontium-90; and 1,000 icro microcuries per liter for gross eta activity.

This the the first time in 15 years (since 1946) that drinking water standards have been revised. The standards form the basis for legally regulating the drinking water used on trains, airplanes, buses and vessels in interstate commerce.

In the revised standards, requirements for water quality were generally raised. Few changes were made in bacteriological standards, but limits for certain chemical pollutants were added for the first time.

Anthraquinone

by Burton L. Hawk

➤ Anthraquinone is an important material for the manufacture of many dyes of the alizarin, anthracene and anthraquinone groups. Alizarin is the most popular of these dyes and carries the distinction of being the first naturally occurring dyestuff to be synthesized in the laboratory. It is prepared from a derivative of anthraquinone — sodium B-anthraquinonesulfonate, commonly known as "silver salt."

The starting material for all of these dyes is *anthracene* which, in turn, is obtained from coal tar. Practically all the anthracene obtained from coal tar is converted to anthraquinone and its derivatives. However, now anthraquinone is produced from phthalic anhydride and benzene and oddly enough, anthracene of high purity can be obtained from synthetic anthraquinone by distillation with zinc dust. This leaves poor anthracene more or less out on the limb. Such are the vicissitudes of chemistry!

Anthracene

In the home laboratory it is most practical to use anthracene as the starting point. You will need material of high purity (M.P. 215-217 deg. C.). Place 50 cc. of glacial acetic acid in a large beaker. Heat the acid until it starts to boil. Then sift in one gram of powdered anthracene. (If your anthracene is crystalline, powder it first in a mortar.) Continue boiling the acid until the anthracene is dissolved.

While this is going on, dissolv four grams of potassium dichromat in the smallest possible quantity o water and set it aside. After th anthracene is dissolved in the acid remove the heat and immediately ad 3 cc. of concentrated sulfuric acid Follow this by the addition of th potassium dichromate solution, dro by drop. (Do not add more than few drops at a time.) A vigorous ac tion takes place and the solution turn dark green. After all the dichromat solution has been added, boil the solu tion again for five minutes. Remov from the heat, add about 50 cc. o water and stir. The anthraquinon separates out of solution. Stir, an then filter the solution. Remove th precipitate by scraping it carefull from the filter paper into a beaker.

Test Product

Now, before proceeding furthe suppose we test our anthraquinon Prepare a solution of sodium hydro ide and pour a small quantity in a te tube. Add a little of the crude anthr quinone just prepared along with small amount of zinc dust. Shake, an heat the mixture gently. Note th liquid starts to turn red. Stop heatin at this point and filter. The blood-re color of the filtrate is due to the o sodium salt of anthraquinol. Let stand for a while and you note th the red color gradually disappears an a precipitate of anthraquinone formed.

Anthraquinone is moderately soluble in chloroform. Add about 100 cc. of chloroform to the crude product you have prepared. Stir thoroughly for a few minutes; then filter. Pour the filtrate in a shallow dish and set it aside in a warm place. The chloroform will evaporate leaving the anthraquinone behind. When it is thoroughly dry, scrape it from the dish and transfer it to a vial or small bottle. Stopper it tightly and label it. Perhaps we will be able to make use of it later on to prepare a dye.

The product as obtained in this manner is a light yellow-green powder. If you desire, it can be further purified by sublimation. The powder is poured into a shallow evaporating dish. Cover the dish with a piece of filter paper which has been perforated with a number of tiny holes (use a pin or small nail for this purpose). Place an inverted watch glass (or an inverted glass funnel) carefully on top of the paper. Set the whole on a wire gauze and apply a very small flame. After a short while light yellow crystals will be deposited on the cool upper watch glass or funnel. The filter paper will prevent them from falling into the exaporating dish below. Remove the heat and carefully scrape the crystals off.

As stated above, anthraquinone is converted into anthracene by distillation with zinc dust. It yields various products on sulfonation, the most important of which is the "silver salt," also mentioned above. It is reduced with alkali and zinc dust, as we have demonstrated, to form the disodium salt of 9,10-dihydroxanthracene (or 9,10-anthradiol). It is quite resistant to oxidation and halogenation is impracticable.

By far the most important use of anthraquinone is as a dye intermediate. However, it does have one other use . . . a rather unusual one: it is used in treating seeds because it makes them distasteful to birds!

On the Back Cover

THE BACK COVER *shows missile-shaped Melter-Washer Tower of new salt water conversion plant at St. Petersburg, Florida. Plant is on Weedon Island in Tampa Bay. The plant is one of a series of saline conversion plants sponsored by the Office of Saline Water. It utilizes a freezing process system developed by Dr. H. F. Wegandt of Cornell University and the Blaw-Knox Company of Pittsburgh, Pa.*

Designed to produce ice crystals — which are pure water — salt water and liquid butane are pumped into either the tower at the left or a rotating basket device being insulated in photo. As the butane turns to a gas, it pulls heat from the salt water, creating a slurry of ice in the brine. The brine is next drained from the slurry and the ice crystals washed clear of any remaining salt water. The ice then moves to a melter unit where the heat throw-off from butane gas under pressure causes it to melt. Potable water is sent to storage tanks and the brine dumped back in Tampa Bay. Daily production of 35,000 gallons is expected.

√ Chemistry Quiz √

Directions: Mark the answer you think *most nearly correct.*
Answers are on page 39.

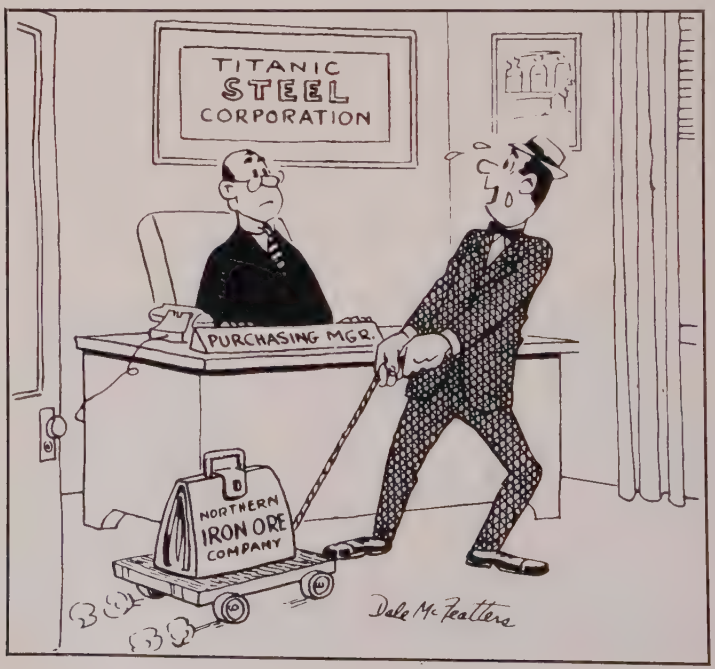
A. Isobutane and n-butane are
1. isotopes
2. isobars
3. isotherms
4. isomers

B. In the electroplating process the object to be plated is used as the
1. anode
2. electrolyte
3. cathode
4. anemometer

C. Which of the following minerals do not contain calcium?
1. apatite
2. quartz
3. calcite
4. vermiculite

D. Which of the following is not a sugar?
1. glucose
2. sucrose
3. lactose
4. saccharin

E. The total number of electrons in the atomic structure of fermium is
1. 100
2. 255
3. 155
4. 55



"Good morning, sir. I represent Northern Iron Ore!"

Abbott

This article continues the series began during the last volume in CHEMISTRY. This series features the major companies employing chemists in the United States. Many of the students now preparing for a career in chemistry will eventually join one or other of the large corporations. This series is intended as a preview into the type work that they will be doing.

Spot, a dog with high blood pressure, jogs into the research laboratory, hops up onto a small table and lies down relaxed while electrocardiograph and blood pressure readings are taken — readings that show possible cardiovascular actions of an experimental drug. In another laboratory, a microbiologist takes a small sample of soil and dilutes it with sterile water, preparatory to isolating microorganisms from it — one of which *may* produce a new life-saving antibiotic. A cell physiologist peers through a microscope while he inserts microelectrodes into an isolated living cell in a tissue culture — the electrical response of the cell gives him clues as to the effect of a new drug on the cell itself.

These are among the activities you might see if you were to tour the Research Center at Abbott Laboratories in North Chicago, Illinois. There hundreds of scientists are at work seeking to discover and develop new drugs for humans and animals and new chemicals for industry and agriculture.

Among the projects toward which they're directing their efforts are infectious diseases (including the common cold), diseases of the heart and circulatory system, the nervous system, metabolism, endocrinology, allergy and nutrition. A few miles from the main plant and research center in North Chicago is a 300-acre research farm that plays an important part in yet another activity — the development of new animal health products. A third aspect of the Abbott scientific effort is research on new industrial chemical products.

Research Center

Center of many of these activities is an eight-story, gleaming glass and aluminum research building dedicated in 1961 that doubled the space previously available to the Abbott scientific division.

This research has advanced rapidly in the last decade and a half. At the close of World War II, Abbott's scientific personnel numbered 150 and its research budget a little more than $1 million. Now that staff has more than 800 members and the company's research expenditures for 1961 will exceed $9 million.

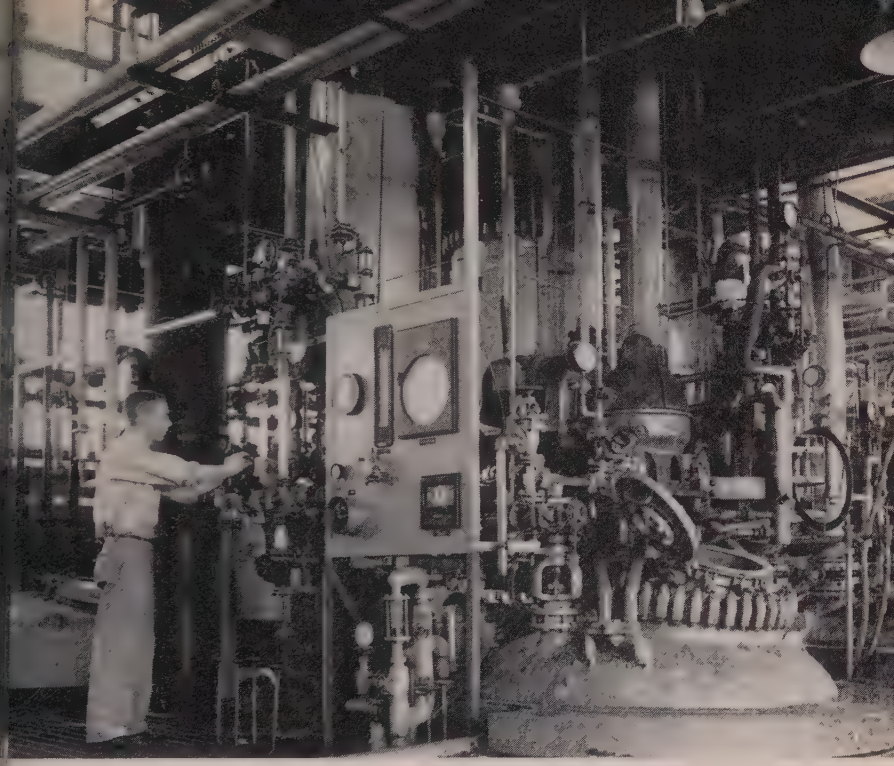
However, to make major advances against organic diseases like heart and circulatory disorders, mental iilness,

➤ New research *center addition at Abbott Laboratories provides* 225,0
square feet of space with the most modern equipment for research in
life sciences. The building, completed in 1960 and dedicated in May, 19
doubles the space available for the company's scientific activities.

degenerative diseases and aging, more must be learned about basic body components and processes and how they are affected by drugs.

Of course, a major portion of the Abbott program is directed toward applied research, developing new products that will treat diseases heretofore unmanageable or will do the job better than products currently available. This may involve the investigation of soils to discover antibiotic-producing organisms. Or it may mean the scrambling of molecules to p duce new chemical substances. O may require the extraction of chemical materials from animal tiss Always is means a large, well-trai scientific staff, large expenditures long odds that the substance disco ed in the laboratory will eventu prove to be an effective and safe d for use in the living person or anir

The company's scientific efforts gan in 1888 when Dr. Wallace Abbott, a Chicago physician, m



TYPICAL CHEMICAL *production center at Abbott Laboratories. Unit with open lid is 1,000 gallon, all purpose, acid-proof reactor that extends beneath the floor. All piping in the labyrinth of plumbing is acid-proof. Center has distillation column and another for "scrubbing" noxious gases. Planned, controlled chemical reactions in such units change structures of molecules in desired ways.*

is first "dosimetric granules" and ecame a pioneer of modern pharma-eutical practice.

When Dr. Abbott began his medi-al practice, most of the medicines vailable were fluid extracts and tinc-ures that often were ill-tasting, un-tandardized and undependable. In nedical school, Dr. Abbott had learn-d of the teachings of Dr. Adolfe Burggraeve, a Belgian pharmacist, who advocated the use of only the effective portion or "active principle" of drug plants instead of the water or alcohol extracts. This active portion could be administered in definite doses in the form of pure granules.

Dr. Abbott was among the first American physicians to appreciate Dr. Burggraeve's methods, and he located

a small company that was producing the dosimetric granules. But he soon became dissatisfied with this source of supply; he often was unable to get the granules when he needed them, and he suspected the supplier was not treating him squarely.

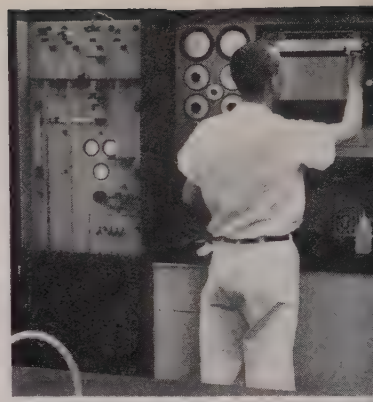
So. Dr. Abbott began experimenting with and making his own dosimetric granules in his home. His patients were well pleased with them, and other Chicago doctors learned of the granules and began buying them from Dr. Abbott. In 1891, he placed a 25 cent advertisement in the Medical World that brought in $8 worth of orders — orders that put "dosimetric granules" on the medical map and Dr. Abbott definitely in business.

Biologicals

When biological preparations came into the foreground, Dr. Abbott's company began to produce them. In 1909, the company made its first organic synthetic chemicals, the phenolsulfamates (antiseptics and disinfectants), and the nucleus of a research staff was formed.

By 1914, the company had advanced chemically so far beyond its early days that the name was changed from the "Abbott Alkaloidal Company" to Abbott Laboratories as it is known today.

The second phase of the company's scientific efforts, from 1916 to 1927, saw the birth and development of a much wider line of products and an advancement of the company's research activities. In 1916, after the announcement of H. H. Dakin and Elexis Carrel of the germicidal action of the chloramines, Abbott developed Chlorazene, Dichloramine-T and Halazone. The latter, an outgrowth of



➤ PROTEIN *research, purity chec studies of nutritional supplements a structural analysis are speeded at A bott Laboratories by this amino a analyzer. It separates, records and c* lects individual amino acid buildi *blocks of protein molecules.*

research on Chlorazene, was used tensively in World War I and Wo War II as a water purification tab It is still in the Abbott catalogue a is employed widely in disaster sit tions where contaminated drink water is suspected and by Boy Sco and other campers to insure that water they drink is safe.

During World War I, the comp was asked by the United States g ernment to manufacture certain s thetic substances previously impor from Germany. Abbott scientists veloped methods of producing a nu ber of sedatives, hypnotics, analge and anesthetics. This work put company into full-scale synthetic m ufacturing.

In 1920, the company introdu Butyn,® a substance for cocaine local anesthetic. Experience during

r in making barbital led, in 1923, Neonal, an intermediate-length rbiturate. In 1922, Abbott acquired e Dermatological Research Laboraies of Philadelphia where arsphenane (Ehrlich's famous "magic bul") was first synthetized in the ited States and where, subsequentneoarsphenamine (a superior agent r treating syphilis) was developed. ne D.R.L. group also developed etaphen,® a powerful but nonnging antiseptic for wounds, skin rilization before operations, and for sinfecting dental and surgical inuments.

hird Phase

The third phase of Abbott scientific hievements began in 1925 when the mpany was moved from Chicago its present site in the far northern burb of North Chicago. In the ars to 1937 an increasing number new products came out of the mpany's growing research laboraries.

Intensive efforts were concentrated the barbiturates in the attempt to id a short-acting form. This research sulted in 1930 in the introduction Nembutal,® a short-acting sedative id hypnotic that has become a classic r inducing sleep and preanesthetic dation. Further research on the barturate molecule to shorten its action sulted in the long-sought intranous anesthetic, which Abbott inoduced in 1934 as Pentothal®Sodin, an ultra-short acting anesthetic hich also has received wide notice a so-called "truth serum."

During this period, Abbott pioneered in the production of vitamin supements that helped to awake the orld to the importance of vitamins. With the discovery that halibut liver was richer in Vitamins A and D than cod liver, Abbott and another company erected a vitamin oil extraction plant in Seattle. Several vitamin products were introduced and the company continued intensive research in nutrition, including work on the B-complex and on synthetic vitamins that today largely have replaced fish oils and other natural sources of the ingredients in today's vitamin tablets.

The next Abbott scientific phase began in 1937 when research activities were materially extended and expanded and the tempo stepped up markedly. Hormones, new arsenicals, and sulfa drugs were introduced. Liver extracts multiplied, and heparin, for preventing blood coagulation, was marketed. The company pioneered in the development of vitamin K, a special purpose vitamin that speeds the coagulation of blood in hemorrhage.

World War II

During World War II, the company, along with others in the pharmaceutical industry, devoted much of its attention to penicillin that saved thousands of lives during the war and afterwards. Abbott also performed research on antimalarial drugs in cooperation with Harvard University, the Office of Scientific Research and Development and others. Diasone,® a drug that first showed promise in treating tuberculosis but later failed, proved to be valuable as an oral treatment for leprosy and is widely used in those areas of the world where this disease is a problem.

In 1945 Tridione® was introduced, the first effective treatment for *petit mal* and related forms of epilepsy.

This was the first of several anticonvulsant drugs the company was to market in the next 12 years for the treatment of several types of epilepsy.

Toward the end of World War II, Abbott began work in radio-pharmaceuticals (purified and standardized forms of radio-isotopes) because medical researchers wanted radioactive Pentothal and Nembutal for studies of the way these drugs work in the body. These and other isotope-labeled drugs were made, and, in 1946, a special research department was established to develop the use of radioactive materials in biology and medicine. As a result of these efforts, Abbott in 1948 became the first pharmaceutical company to supply finished radio-pharmaceuticals to medical and research institutions.

At first, processing of the isotopes was carried on at the main plant in North Chicago, but in 1952 the company established a radio-pharmaceutical production center at Oak Ridge, Tennessee, where all of the company's commercial isotope development and production facilities are now consolidated. Until 1960, Abbott obtained all of its crude isotopes from the Atomic Energy Commission's nuclear reactor at Oak Ridge. However, the company now produces some of its own raw material for radio-pharmaceuticals.

Medical Products

During the 1950's a number of medically-important products were developed, including Desoxyn,® central nervous system stimulant and appetite inhibitor; Selsun,® for the control of dandruff and other dermatological conditions; Erythrocin,® an antibiotic especially effective against coccic infections; Tronothane,® a topical anesthetic of low toxicity; Compocillin-VK, a new and more effective salt penicillin; Spontin,® a new antibiotic that kills many bacteria outright and is effective in many severe infections and Tral,® for the treatment of ulcers.

A chance discovery by a graduate chemistry student at the University of Illinois led to the introduction in 19[illegible] of one of the company's most widely known products. The student had been preparing a number of compounds in his laboratory and paused to light a cigarette. He laid the cigarette on his lab table and when he put it back in his mouth, he noticed it tasted sweet. The student went to work for another chemical company but the Abbott research director heard one story and began to investigate the possibility as a non-caloric sweetening agent. After nearly a decade of research and development that proved the compound was safe and could be used in a wide variety of food and beverages, it was introduced in 19[illegible] under the trademark of Sucaryl. Since then it has been used by millions of persons on diabetic or reducing diets.

Major Expansion

A major expansion of scientific efforts was decided upon by management in 1956, and the company began adding gradually and steadily to the scientific staff in anticipation of the new research facilities that were completed in 1960. About half of the more than 800 members of the scientific divisions are professional scientists who hold degrees in a score of more different scientific disciplines. About a third of them are Ph.D.'s and M.D.'s.

During a recent year, more than ,500 materials from chemical, mi-bial and other sources were pre-red and evaluated at Abbott. In 61, a record number of potential w drugs were under investigation.

Current basic research projects at bbott include studies on the func-ning of the individual cell, the ac-n of drugs at the cellular and mo-ular level, nerve growth factors, the echanism of action of diuretics, and ndamental investigations of cancer, etabolism and host defense mechan-ns. One of the company's basic re-arch projects is the study of enzymes at do much of the work of the cell accelerating the building up and aring down of chemicals in the dy. One phase of enzyme research volves the isolation of enzymes from ochemical material for clinical use treating disease. Our scientists are vestigating an enzyme that appears, early trials, to be of value in man-ing certain circulatory diseases.

nzyme Inhibitors

Another approach is represented by vestigations to discover and develop emicals that affect the action of nzymes. Of particular interest are mpounds that inhibit the monamine idases, enzymes that have been im-icated in metal depression and high ood pressure.

A unique, multi-stage screening rogram involving biochemical, neuro-armacological, animal and behavior-al tests has enabled Abbott to put on clinical trial new types of monamine oxidase inhibitors unlike any currently available.

New Anesthetic

Some drugs have been marketed in a prolonged release dosage form known as the Gradumet,® and others are planned for future introduction. Enduron™, a potent oral diruetic, is proving valuable in lowering blood blood pressure in hypertensive patients and in treating edema, in which excess fluids accumulate in the tissues of the body. Expected to be introduced within the next few months is Penthrane™, a new inhalation enesthetic that is non-flammable and minimizes the possibilities of overdosage. Thousands of compounds are being evaluated in a cancer-screening program. New veterinary products and new chemicals for agriculture and industry also are in various stages of development.

The company's bread line of about 550 products that improve and protect the public health includes many that were not even imagined by the physicians of Dr. Abbott's day. But there are yet major diseases to be conquered. Perhaps someday the basic research that is now being done will result in the control of mental illness, cardiovascular diseases, cancer, metabolic diseases and other organic disorders. It is toward these goals that Abbott and other scientists are striving.

√ Answers to CHEMISTRY QUIZ on Page 32. A - 4; B - 3; C - 2; D - 4; E - 1. √

Enzyme-Substrate Complex

Thomas J. McGivern, 17, was a winner in the 20th Science Talent Search. He hopes to major in chemistry at college with a view to becoming a research biochemist.

by Thomas J. McGivern

Highland Park High School, Highland Park, Illinois

➤ A biochemistry laboratory experiment and an article in *Scientific American* magazine entitled "The Enzyme-Substrate Complex" turned my interest toward enzymes, more specifically, enzyme kinetics and the enzyme-substrate complex. The enzyme-substrate complex is the most logical, and most widely supported and accepted theory for the mechanism of enzyme catalytic action. It is theorized to be a transitory compound of enzyme and substrate, an intermediate action which supposedly distorts the substrate into a highly-reactive state. Leonor Michaelis and Maude Menton, of Berlin, are credited with the proposal of the theory in 1913. Although evidence points to the existence of the complex, the compound itself has never been successfully isolated for study because of its transitory nature.

This study of the enzyme-substrate complex is divided into two parts.

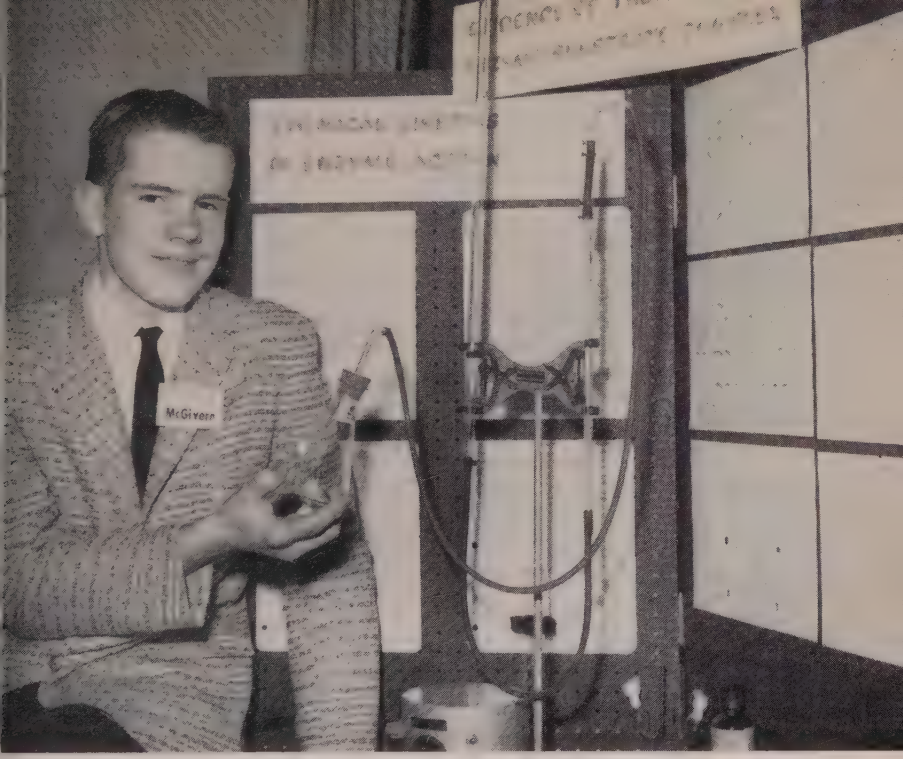
The first is a study of the kinetics, or rates, of the actions of the yeast zymase group and catalase. I am interested here not in the relationship of initial rates to certain variables, but in the progress of each reaction with time. A comparison will be made with the results of Dr. Britton Chance, th University of Pennsylvania, wh measured directly the varying conce tration of a complex during reactio he used specialized mixing and flo techniques and a highly-sensitive spe trophotometer. If, as he conclude rate of product formation is direct proportional to complex concentratio the curve path on my rate-time grap map appear roughly similar to th on his complex concentration grap The second part is a study of he stabilization of invertase. If a compl is formed, the presence of sucrose su strate during heating may protect t active sites of the invertase molecul from denaturation.

Methods and Materials

Enzymes Used: Catalase and vertase were technical grade, suppli by Nutritional Biochemicals Corpo tion. Fleischman brand yeast w used.

Incubation: A home-made wa bath incubator was used. Yeast w incubated at 30° C and invertase 38° C. Catalase was not incubat but run on a magnetic stirrer.

Measurement of Yeast Zymase A tivity: Smith tubes were used for t



THOMAS J. MCGIVERN *shows his science display at an exhibition held in Washington as a feature of the twentieth annual Science Talent Institute. Thomas was one of the 40 S.T.S. winners who were chosen from over 9,000 high school seniors throughout the country.*

action. Toward the end of the re-tion steps, pyruvic acid breaks down carbon dioxide and acetaldehyde. he carbon dioxide collected and easured in the calibrated sidearm of e tube provided a measure of the t activity of the zymase group. The itial substrate was glucose. Readings ere taken every five minutes for one ur.

Measurement of Catalase Activity: constant-pressure water manometer as constructed to measure the molec-ar oxygen evolved by the break-down of hydrogen peroxide substrate. A phosphate buffer of pH 7.0 was used. The reaction was run in a flask on a magnetic stirrer, with readings taken each minute until manometer capacity was reached.

Invertase Experiments: For these experiments, heating was done by immersing test tubes in a boiling water bath. An acetate buffer of pH 4.5 was used with the invertase, and sucrose was the substrate. In one tube, invertase was heated; in a second, invertase with sucrose; and in a third,

invertase with thiamine hydrochloride, a substance chosen at random. Three more tubes served as controls: one contained invertase and sucrose, another contained only invertase, and a third had glucose solution. The latter three were not heated. After heating and cooling, sucrose was added to the first and third tubes, and then all were incubated for 16-24 hours. Each was then analyzed with Benedict's Qualitative Sugar Reagent. Enzyme activity was determined by detecting glucose, one of the reaction products.

Results

The readings taken during kinetics experiments were plotted on graphs, with amount of product formed as ordinates and time as abscissas. Some were also plotted with rate of product formation as ordinates and time as abscissas. The curve shapes for catalase and for the yeast zymase group appeared quite similar. First, there was a short initial increase in rate. The rate then leveled off to a steady state. Finally it began to decline slowly and would have reached zero if followed further.

Results of the heat stabilization experiments as indicated by Benedict's Qualitative Reagent were as follows: tubes with invertase alone (heated) showed no glucose. The tubes heated with invertase and sucrose showed a significant amount of glucose. The tubes heated with enzyme and thiamine gave an inconclusive result, but there was probably no glucose. The unheated tubes containing invertase and sucrose showed more glucose than the heated ones of the same type. The control tubes indicated that the analysis was probably valid.

Discussion

The actual rates of action of diffe ent enzymes will differ because son are more active than others; this a tivity is indicated by the turnover, th maximum number of substrate mol cules whose conversion is catalyze by one enzyme molecule in one mi ute at a standard temperature. Th *shape* or *path* of rate curves of diffe ent enzymes may be quite simila however. The transient phase (initi rate increase) is probably due to a initial buildup of complex concentr tion. The steady state, present wh the substrate supply is in excess rel tive to that of the enzyme, is a zer order reaction; the rate here is limite by the complex-forming capacity the particular enzyme. The decline due to a decrease in complex conce tration; it follows the course of a firs order reaction, which ideally is pr portional to decreasing reactant co centration. However, in enzymes, th decline is often caused by inhibitio of the enzyme by its own substrate, product, or extraneous materials. Th comparison with Dr. Chance's grap showed the two to be somewhat sim lar. Although my experiments are n accurate enough to be conclusive, does appear that, during any time the reaction, rate of product formatio is directly proportional to concentr tion of the intermediate complex that time.

In the invertase heat stabilizatio experiments, the activity of inverta when heated alone was destroyed expected. However, when heated wit sucrose substrate, it retained some its activity. This partial protectio may be due to a complex formatio The effect of thiamine hydrochlorid

s not been elucidated clearly, but it obably offers no protection to the zyme, that is, does not complex th it. In the future, I would like to t the heat stabilization effect of rtain dyes which are known to mplex with invertase. Also, I may equilibrium dialysis with invertase d dye to see how many dye mole-les are complexed per invertase olecule.

Some error has undoubtedly been stilled into these experiments rough the use of technical grade zymes and through my lack of nowledge of many techniques. The ast zymase group, besides being mposed of twelve enzymes, cata-zes reactions which are a metabolic ocess, and thus there are also some le reactions. However, these experi-ents have answered some of my estions and have taught me a great al. This paper covers the work of out five months, two for prelimin-y preparations and three for actual perimentation. The work was done om December 1959 to May 1960, ring the school year.

he Enzyme-Substrate Complex

Enzymology is an important area biochemistry, for without the action these biological catalysts, life would be virtually impossible. However, it is not enough to say that enzymes act as catalysts. We want to know the mechanism for enzyme catalysts. The enzyme-substrate complex is the most logical mechanism, most widely accepted, and strongly reinforced by experimental evidence. The complex is a transitory, intermediate compound of the enzyme and its substrate. All attempts to isolate the complex and study it have failed, due to its extremely short life.

My work consisted of two studies. First, I decided the reaction rates of two systems: the anerobic metabolism of glucose, catalyzed by the twelve enzymes of the yeast zymase group, and the breakdown of hydrogen peroxide, catalyzed by catalase. Results of reaction rate studies often give clues as to the reaction mechanism involved. The second part was a study of the heat stabilization of invertase by its substrate sucrose. Ordinarily the active sites, centers of catalytic activity on the enzyme molecules, are denatured and lose their activity when subjected to heat. However, I found that when sucrose was present during heating of invertase, the enzyme was protected and retained some activity. This effect may well be due to the formation of the enzyme-substrate complex.

Data from Experiment 2

ube 1:	invertase, water, buffer	(sucrose added after heating)
ube 2:	invertase, water, buffer, sucrose	(water added after heating
ube 3:	invertase, water, buffer, thiamine hydrochloride	(sucrose added after heating)
ube 4:	invertase, water, buffer, sucrose	(control, not heated)

Tubes 1, 2, 3, heated at 80° C for 2 min., then all tubes incubated at 38° C for 22 hours.

Analysis

	Color of Sample	*Interpretation*	*Reason*
Tube 1:	Blue	No glucose	Enzyme inactivated
Tube 2:	Blue-green	Glucose produced	Enzyme protected
Tube 3:	Blue, slight white pp't	No Significant action	Uncertain-enzyme probably unprotected
Tube 4:	Yellow-green	More glucose than #2	Control, not heated Optimum condition

Reagents Used

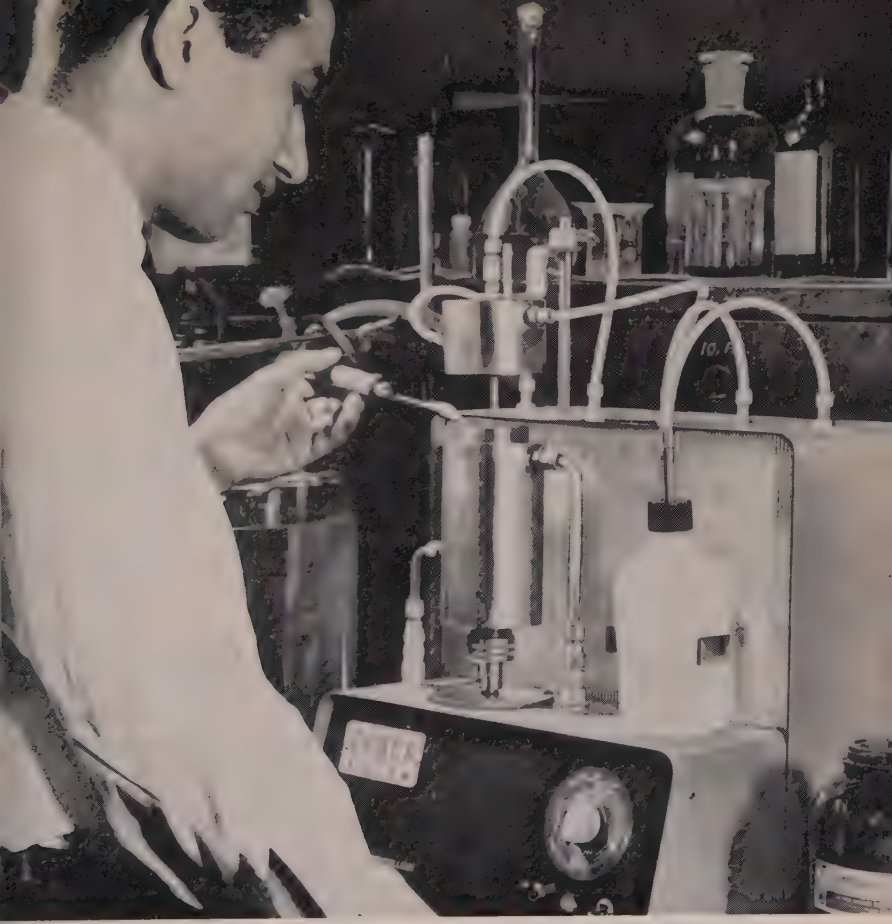
Yeast Zymase	*Concentration*	*Amount in each reaction unit*
d-Glucose	10%	2ml
sodium iodoacetate	0.02M	(2ml, inhibitor
potassium biphosphate	0.045M	2ml
media		
thiamine hydrochloride	0.34g/liter	5ml
magnesium sulfate	0.65g/liter	
manganous sulfate	0.21g/liter	
yeast suspension	4g/25ml water	5ml
Catalase		
hydrogen peroxide	3%	2ml
tech. catalase solution	0.5ml/100ml water	2ml
buffer- pH 7.0		
sodium hydroxide	0.1M	4ml
potassium biphosphate	0.1M	
Invertase		
sucrose	5%	1ml
tech. invertase solution	0.2 ml/100ml water	5ml
buffer- pH 4.5		
acetic acid	0.1M	2ml
sodium acetate	0.1M	

The above amount may be varied for different experiment

Benedict's Qualitative Sugar Reagent

8 drops test in 5ml Benedict's, or
4 drops test in 2.5ml Benedict's

Heat samples 5 min. in boiling water, a precipitate indicates presence of glucose.



pparatus Article

Automatic Recrystallizer

A NEW recrystallizer which auto-atically purifies small quantities bout one gram) of organic com-unds in the laboratory with a mini-um of attention by laboratory per-nnel has been introduced by Central ientific Company, a division of Cen- Instruments Corporation.

Called the Automatic Recrystallizer, the new instrument is designed to be particularly useful where very pure materials are required for analysis, comparison or inspection in analytical or industrial quality control laboratories. It also allows the use of the more economical, lower grade chemi-

cals which usually deterioriate in shipment or storage. These chemicals can be upgraded immediately in the laboratory using the Automatic Recrystallizer.

The Automatic Recrystallizer is of particular value in the laboratory because it is fully automatic and releases personnel for more valuable non-routine work. It gives precise control over purification parameters and is excellent for qualitive analysis work.

The Recrystallizer's one-hour program may be continuously repeated and stopped automatically after one cycle.

The new instrument requires only a space of 12 inches by 12 inches on the laboratory bench and can be us in any laboratory equipped with n mal utilities. The unit requires c nections only to an air pressure out about 25 inches Hg, and cold or h water (or oil or steam).

The crystallizer chamber is ma of stainless steel and monel me throughout, the connecting tubing polyethylene, all of which are corrosi resistant and easily cleaned. The u weight about 25 pounds.

Complete technical data on t Automatic Recrystallizer may be tained by writing Central Scienti Company, a division of Cenco Instr ments Corporation, 1700 West Irvi Park Road, Chicago 13, Illinc U.S.A.

Arthritis Research Clue

➤ Promising results in treating rheumatic disorders of a small group of patients with epsilon amino caproic acid, or EACA, were reported.

Dr. Jerome Rotstein of Montefiore Hospital found this important research clue for the study of connective tissue diseases, of which rheumatoid arthritis is the most severe.

EACA was first synthesized by German chemists in 1907, and in 1953 Japanese scientists reported that it had potential use in control of acute bleeding conditions associated with high plasmin levels. It was this factor that led Dr. Rotstein and his colleagues to undertake exploratory studies for its possible use in treating connective tissue diseases.

No conclusive results have been shown yet in the treatment of rheumatoid arthritis, but progressive systematic sclerosis, a severe connecti tissue disease, has responded to t compound.

EACA acts on an enzyme syste which is the fibrinolytic system l lieved to be involved in the mecha ism of inflammation. It blocks t activation of plasminogen into pl min, which reduces fibrin, an ins uble gel form of fibrogen that occu during the clotting of blood.

When fibrin is split up (fibrino sis), the remaining fibrin products believed to be involved in the develo ment of fibrinoid lesions present arthritis and in other inflammato lesions.

Lederle Laboratories at Pearl Riv N. Y., has been doing developme work on EACA, but there is no pr pect of its commercial production this time.

New Chemical Patents

To obtain copies of these new patents, order them by number from the Commissioner of Patents, Washington 25, D. C. Enclose 25 cents in coin, money order or Patent Office Coupon (but not stamps) for each patent ordered.

acturing Oil Wells sing Calcium Carbide

In the usual method of fracturing well, the zone of the well to be ctured is packed off and a fracturg fluid is injected into the isolated ne. The pressure of the fracturing id is increased, usually by the intion of additional quantities of the id, until the isolated zone is rupred or fractured.

When using this method, the engy available for fracturing is deed solely from mechanical apparas located at the surface of the well. a result, the force which may be veloped in the desired zone has a ry definite limitation, thereby limng the extent to which the well may fractured.

Michael W. Barrett of Seminola, klahoma, has devloped an improved ethod for fracturing oil wells which lizes calcium carbide. He has been arded U. S. Patent No. 2,943,681 his invention. The patent is unasgned.

His method involves the pumping calcium carbide suspended in a uid hydrocarbon carrier into the ne of the well to be fractured. This followed by sufficient water to react th the calcium carbide to form etylene. The force developed from s reaction is sufficient to rupture or cture the zone.

This method increases the size of the fractures around a well without increasing the horsepower requirements of the apparatus used. It also utilizes chemical energy in the place of mechanical energy.

Protection Against Frost Damage

➤ Frost or freezing temperatures cause heavy economic losses in many forms of plant life. A simple and inexpensive method of preventing or minimizing frost to plant life has long been sought. Previous methods include preventing heat radiation by the use of smoke, heating of the air by fuel burners and providing cover for plants in the form of paper or cloth shields.

Louis E. Wells of Jackson, Mississippi has developed a new method for protecting living plants from frost damage. He was given U. S. Patent No. 2,961,798 for his invention. The patent was assigned to Dumas Milner Corporation of Mississippi.

His method consists in applying to the plants butyrolactone, 2-pyrrolidone or N-lower alkyl-2-pyrrolidone. This is accomplished with a spray containing from 0.01 percent to about 2 percent of the compound. The spray also contains water, oil-in-water emulsions, glycols, oils or other non-phytotoxic liquid carriers.

Book Condensations

CHEMISTRY FOR THE SPACE AGE — Dan Q. Posin — *Lippincott,* 680 p., illus., $5.60. Lively introduction to chemistry with tests, application exercises and problems to solve following each of the 62 sections.

CHEMISTRY FOR CHILDREN — Virginia L. Mullin — *Sterling,* 117 p., illus. by Bernard Case, $2.95. Introduces boys and girls to the language of chemistry and laboratory techniques, and gives instruction for many experiments.

NATURAL POLYMER MAN-MADE FIBERS — C. E. Carroll-Porczynski — *Academic Press,* 303 p., illus., $11.20. Presents results of recent scientific investigations for readers engaged in manufacture or in research and development work of organic man-made fibers.

PLASTICS IN NUCLEAR ENGINEERING — James O. Turner — *Reinhold.* 139 p., illus., $5.50. Covers practical plastics applications from the viewpoint of the engineering dealing with nuclear research apparatus.

THE ORGANIC CHEMISTRY OF BORON — W. Gerrard — *Academic Press,* 308 p., $9. Monograph treats comprehensively the reactions and techniques used in the organic chemistry of boron.

ANALYTICAL CHEMISTRY OF THE RARE EARTHS — R. C. Vickery — *Pergamon,* 137 p., illus., $6.50. Considers gravimetric, volumetric, spectrophotometric, spectrographic, X-ray and polarographic techniques of analysis.

A SYSTEMATIC LABORATORY COU IN GENERAL CHEMISTRY — Harry Sisler, Jay H. Stewart and W. Lippincott — *Macmillan,* 2nd e 358 p., illus., paper, $4. Revision e phasizes quantitative experiments a importance of the student's own terpretation of experimental resu obtained.

EXPERIMENTAL NUCLEAR CHEMIST — Gregory R. Choppin — *Prenti Hall,* 226 p., illus., $9.25. Combi basic theory with the latest techniq in the expert use of radioisotopes modern research, describes exp ments using license-free quantities radioisotopes of low activity, t eliminating special safety requi ments.

PHYSICAL CHEMISTRY OF MAC MOLECULES — Charles Tanford *Wiley,* 710 p., illus., $18. Gradu text and reference book, emphasis theoretical principles, major ar treated are molecular structure, t modynamics, light scattering, visc ty, electrostatics, and equilibria a kinetics of reactions.

CHEMISTRY — Michell J. Sien and Robert A. Plane — *McGr* 2nd ed., 623 p., illus., $7.50. Fi year college courses emphasizing p ciples, with hunderds of problems t call for comprehension in their s tion.

SEPARATION PROCESSES IN PRACT — Robert F. Chapman, Ed. — p., illus., $4.95. Practical informat for the young chemical engineer.

Chemistry Comments

Matches can be water-proofed by pping tips in melted paraffin.

The chief advantages of radioisope-fueled generators for space use e their small size, light weight, long e and reliability.

Under heavy fallout conditions, a ield of one to two yards of earth or ncrete is needed for full protection gainst gamma radiation.

A 10% to 20% loss of salt from the dy leads to loss of will to work.

Isinglass, mineral mica, formerly ed as windows in oil stoves, now is strategic importance to the elecnics industry because of its excelnt electrical insulating properties.

Corrosion of iron and steel in salt ater is an electrochemical phenomen.

Over half of all the money that the .S. has spent on research and delopment in its entire history has en spent in the last 10 years.

The mechanical properties of acryc plastics are improved by the alignent of molecules in the plane of the eet.

Azaleas and camellias cannot toler-e high soil salinity although they ow best in acid soils.

A remote-controlled miniature emistry laboratory which will break wn small samples of the moon's soil d report back to earth what chemils it finds is being developed to be nded on the moon in 1963.

➤ Cadmium has long been recognized as a potentially toxic material to humans.

➤ Ancient man mined large quantities of gypsum minerals from caves in Mammoth Cave National Park area 3,000 years ago.

➤ Plasma, termed the "fourth state of matter," along with solid, liquid and gas, is simply very hot, electrically charged gas, observed in such everyday uses as fluorescent lamps and electric arc lamps.

➤ Boron, used in high energy rocket fuels, is now applied to cancer research.

➤ Radioactive krypton used for measuring cerebral blood flow is largely eliminated during a single trip through the circulation.

➤ Laboratory-grown "whiskers" consisting of a single crystal of alumia can withstand tensions up to several million pounds per square inch.

➤ The strength of pure silver is increased five times by blending into it a small percentage of tiny sapphire "whiskers."

➤ Sheep fed alfalfa pellets containing 5% of dicalcium phosphate are protected against poisonous oxalates in weed.

➤ The traditional method of making leather may be revolutionized by a new proteolytic enzyme, keratinase, which removes natural hair from hides without affecting them, producing a better quality leather.